Heating Piping & Air Conditioning

NOVEMBER 1959

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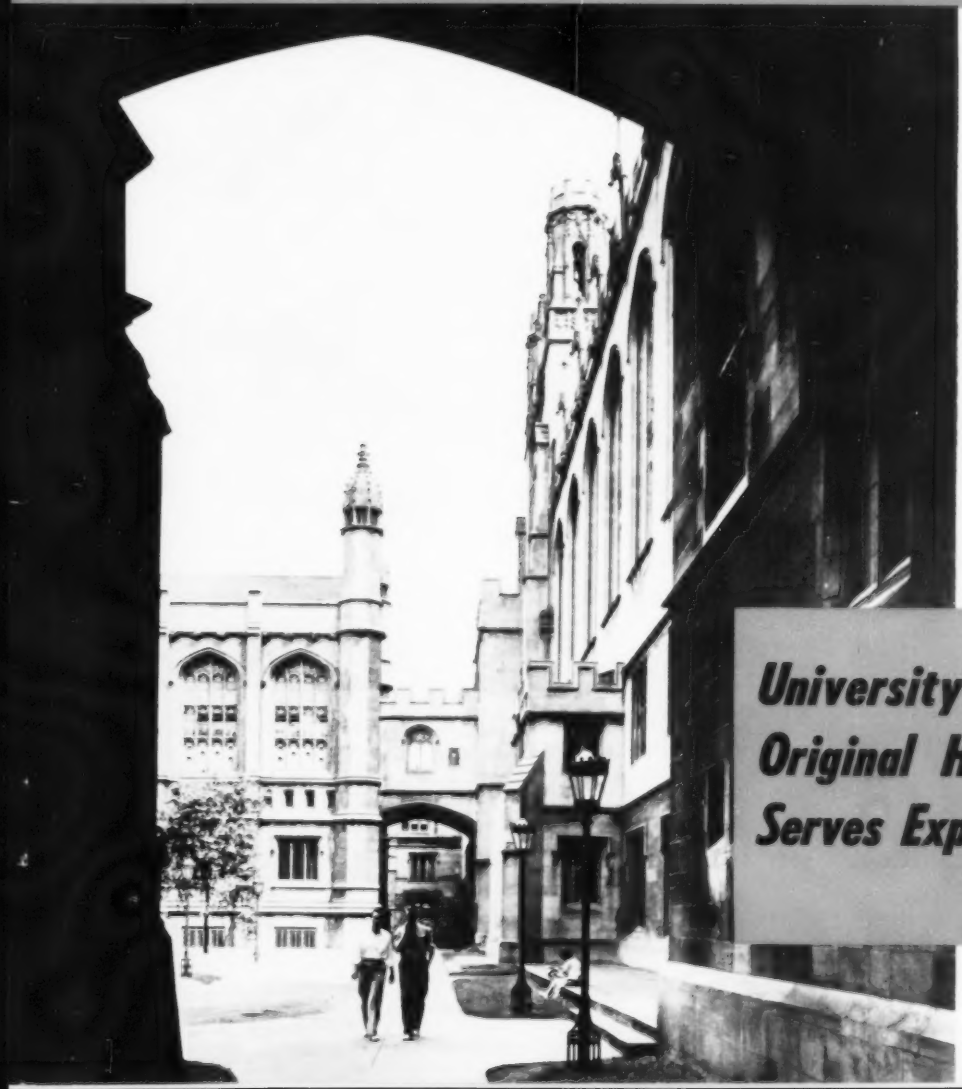
. . . for Consulting Engineers • Mechanical (Heating, Piping, and Air Conditioning) Contractors • Engineers with Plants and Big Buildings



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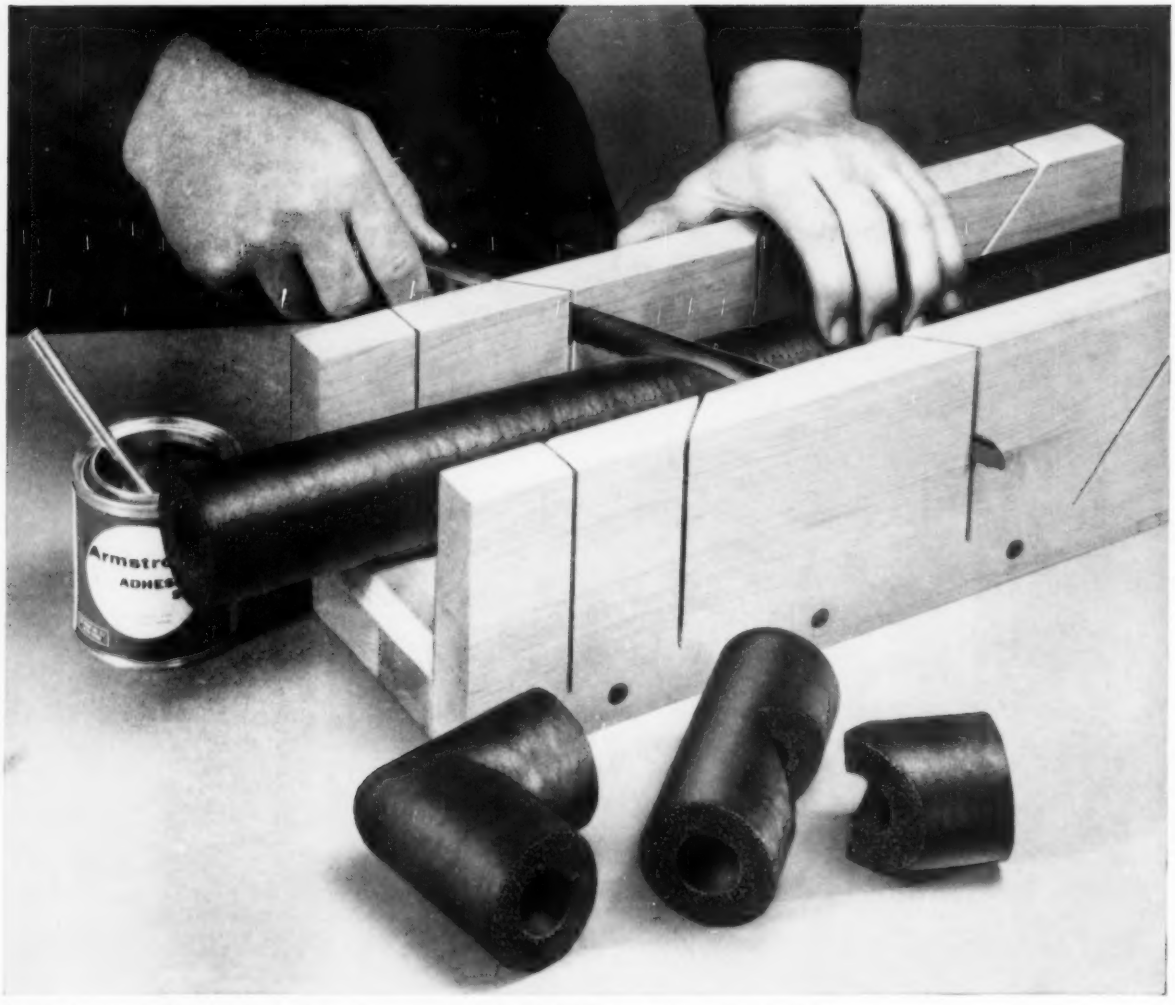

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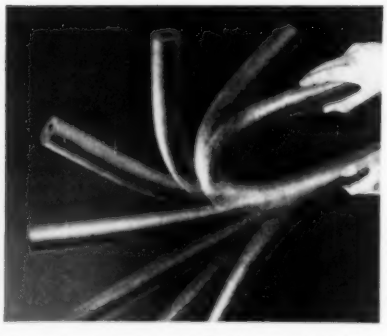

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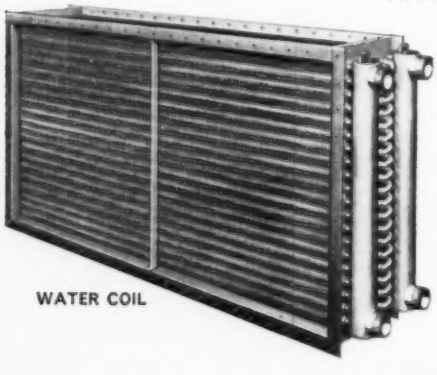

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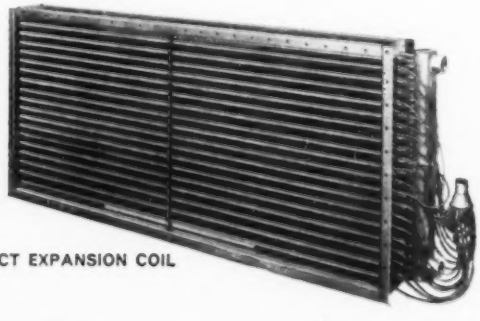

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Vol. 31, No. 11

November 1959

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Why a Steam Trap Has to Handle "Air"

Low temperatures and corrosion of equipment are often evidence of inadequate trap air venting capacity

Air, with its load of oxygen and carbon dioxide, has an unwholesome habit of interfering with the efficiency of steam heated units. If steam were always free of these undesirable companions, things would be a lot simpler for men-who-operate-plants. Because it isn't, three unhappy situations frequently occur:

1. ***Operating temperatures are subnormal.*** This is a two-part problem. First, an air-steam mixture has a lower temperature than pure steam at the same pressure—see Table A. Secondly, air can "plate out" on heat transfer surfaces as shown in Figure 1. Under some conditions, such an air film will knock down heat transfer efficiency by as much as 50%.

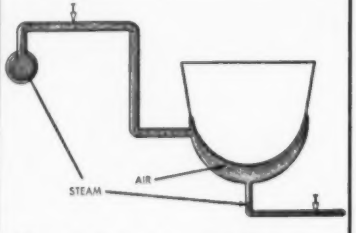


Fig. 1. *How air can "plate out" on heat transfer surfaces. This "insulation" drastically reduces heat transfer efficiency. Armstrong trap operation creates turbulence in the equipment that prevents this.*

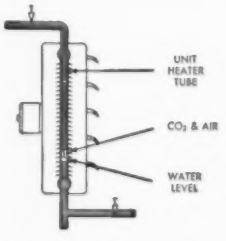


Fig. 2. *Corrosion occurs when units are not kept continuously free of both condensate and air. Armstrong traps discharge both,* at steam temperature, *as fast as they accumulate.*

2. ***Corrosion rears its ugly head.*** Oxygen and carbon dioxide are real trouble-makers. CO_2 gas goes into solution in condensate, forms carbonic acid and chews away at vulnerable metal sections. O_2 aggravates the situation. See Figure 2.

TABLE A—How air reduces steam temperature.

Gauge Pressure	Temp. of Steam with No Air Present	Temp. of Steam Mixed With Various Amounts of Air (% Air by Volume)	
		10%	30%
10.3	240.1	234.3	220.9
25.3	267.3	261.0	246.4
50.3	298.0	291.0	275.1
75.3	320.3	312.9	295.9
100.3	338.1	330.3	312.4

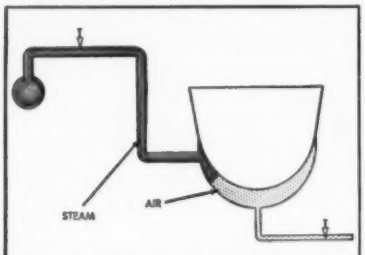


Fig. 3. *When steam is turned on, it takes a trap with extra air venting capacity to provide fast heat-up.*

3. ***Heat-up is slow as a snail.*** Air has a picnic in units that are shut off periodically. Figure 3 pictures the problem. Lines and equipment literally fill up with air. When the steam is turned on it can get in only as fast as the air gets out.

Enter Steam Traps

Curing these steam system ailments involves an operation sometimes called a "trap transplant." It consists of removing traps that don't get the air out and replacing them with traps that do.

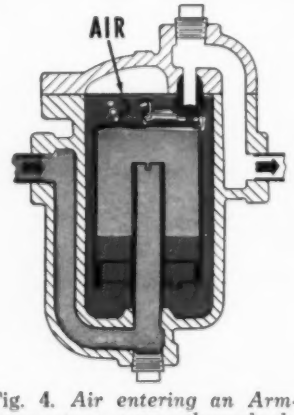
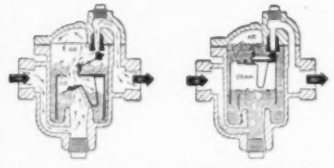


Fig. 4. *Air entering an Armstrong trap passes through the bucket vent and accumulates in the top of trap. When trap opens, air is discharged along with condensate.*

Figure 4 shows how an Armstrong inverted bucket trap continuously vents air. What the picture doesn't show is a built-in plus-value of this trap's design. An Armstrong trap opens suddenly, creating a momentary pressure drop and turbulence in the unit being drained. This breaks up air films and "pumps" air down to the trap so it can be vented.

The vents in standard Armstrong trap buckets will pass all the air normally encountered. In special cases, such as paper machine dryers, the vents are correctly sized larger at the factory to meet the requirement.



Thermostatic vent open. *Thermostatic vent closed.*

Fig. 5. *Open float with thermostatic vent for off-and-on units. When trap is cold, vent is open, permitting air to blow through when steam is turned on. When steam reaches trap, heat closes thermostatic vent. Then, regular bucket vent handles all air coming in with steam.*

Open Float with Thermostatic Vent

Super air-venting capacity is a must for fast heat-up of low pressure unit heaters, heating coils, steam headers and other units that are on-and-off. Figure 5 shows how the Armstrong open-float-with-thermostatic-vent trap takes care of this.

* * *

The 44-page Armstrong steam trap book covers other features of the Armstrong trap as well as its excellent air handling characteristics. This catalog also discusses trap selection, installation and maintenance. Your local Armstrong Representative or Distributor will be glad to give you a copy. Call him, or write Armstrong Machine Works, Maple Street, Three Rivers, Michigan.

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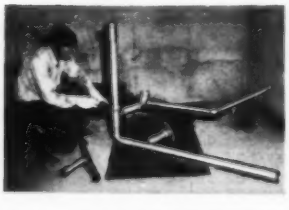

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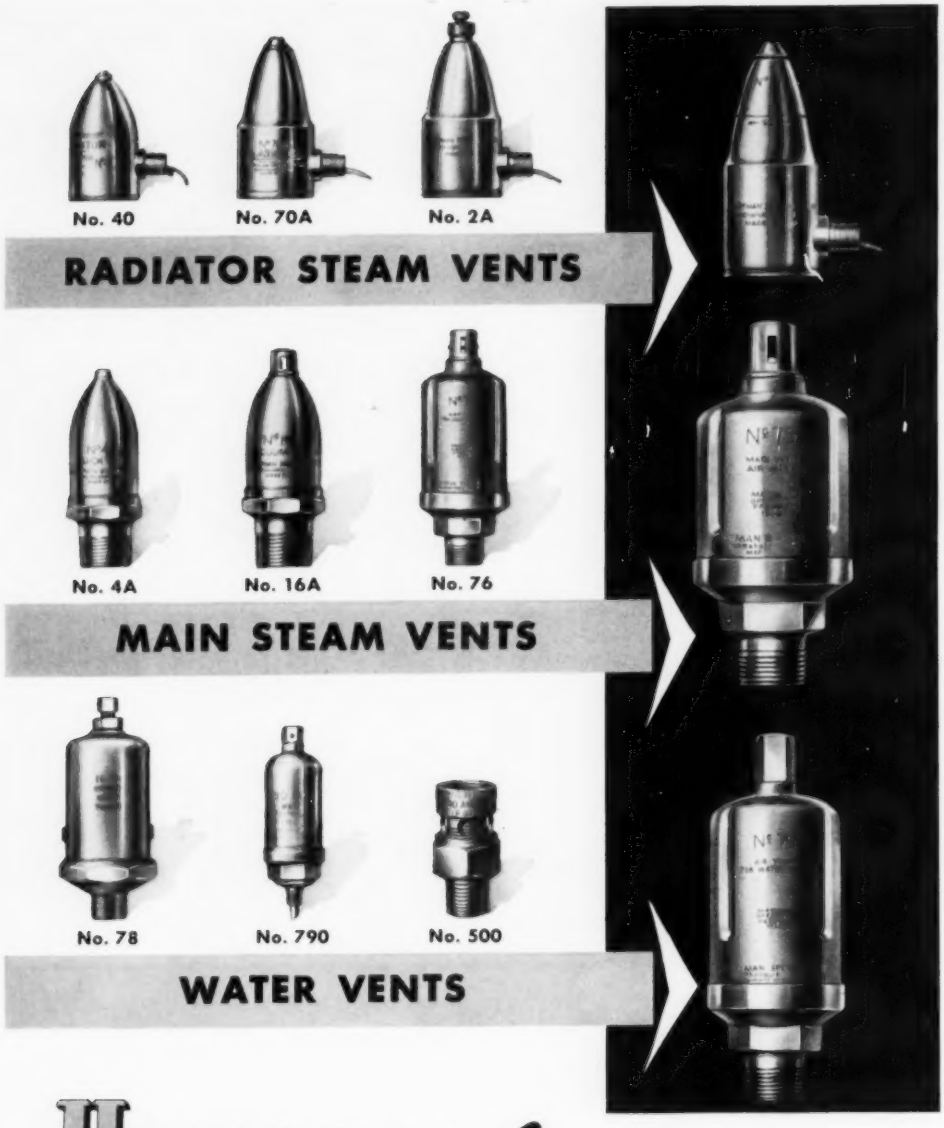

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LETTER FROM THE EDITOR

November 1959

Dear Reader:

The large central heating system at the University of Chicago has delivered approximately 12 billion lb of steam to meet the heating, cooling, and various other needs since it was first put into operation 30 years ago this month. This system, consisting of four 1200 hp coal fired watertube boilers, has been in continuous use since 1929, and the system's original piping and boiler tubes are still in use. Even though the heated space has increased considerably since 1929, sufficient boiler capacity still remains to serve further expansion from the present 63 million cu ft to almost 95 million cu ft when added. Lyman R. Flook, formerly Superintendent of Buildings and Grounds at the University, explains, in his article on pages 97 to 101, how this large system has been operated and maintained during this 30 year period so additional boiler capacity has not been required.

The process piping systems in the new blood fractionation laboratory at the Michigan Department of Health are a very important link in the processing of fresh and outdated blood from various sources. Anton Krapek discusses the processes and explains how the piping systems were designed to meet the unique needs of this new laboratory in his article on pages 102 to 105. The importance and necessity for many sanitary precautions in processing biologic material and the high standards that are necessary to insure safety in their use in the human is explained by Mr. Krapek.

The new sheet metal duct manual is a new tool for engineers and contractors which will undoubtedly bring an end to confusion and misunderstanding in the design and installation of these air distribution systems, according to James H. Stiggleman in his article on pages 106 to 109. This new manual is the contribution of the Sheet Metal and Air Conditioning Contractors National Association and is the result of compilation of extensive data by SMACNA.

A consulting engineer's views regarding his responsibilities and fees for his services are presented by Ralph M. Westcott on page 112. Along with this is an engineering contractor's view of consulting engineer's problems by A. I. McFarlan on page 113.

Air conditioning keeps perishable photographic supplies fresh in Eastman Kodak Company's distribution center, according to L. V. Quadrini in his article on pages 118 to 120. Seven different systems provide cooling for the offices, the storage areas, the electronic computer installation, and the cafeteria. Both built-up and package systems are used. For areas of 13,000 sq ft and larger, the built-up system is used. Equipment, ducts, and pipes for the storage areas are installed on the roof to save space and to eliminate the possibility of leaks causing damage to photographic supplies.

To control corrosion and improve heat transfer in steam heating systems, Dr. Malvern F. Obrecht explains in his article on page 121 how filming amine inhibitors can provide economical and efficient protection for metal surfaces. These inhibitors also exhibit "detergent" action on already fouled surfaces by displacing and removing corrosion deposits and other fouling layers. They promote dropwise condensation and "sweeping" run-off, which also contribute to increased heat transfer. Dr. Obrecht includes several examples showing heat transfer relationships with the fouling factor reduced as a result of filming inhibitors.

Recommended loudness limits for noise from heating and air conditioning equipment are given in the HPAC Data Sheet on pages 129 and 130. The new limits are in three levels that are referred to as very quiet, quiet, and slightly noisy. The author, Dr. Howard C. Hardy, shows how total loudness may be computed by following six easy steps using these loudness limits and a loudness graph, also included as a part of the Data Sheet.

Condensers and how they function is explained by Lester T. Avery in his Tricks and Trends article on page 131. He points out many condenser maintenance procedures and tips for good performance that should be helpful in assuring continuous operation of air conditioning systems.

A new pipe welding procedure using inert-gas tungsten-arc welding with new consumable insert rings is explained by Helmut Thielsch in his article on pages 132 to 135. He shows how the new silicon deoxidized consumable insert ring has solved the problem of bubbling and porosity in joining carbon steel pipe. Of course inert-gas tungsten-arc welding has been used extensively in joining stainless steel pipe and tubing, but it has been limited on carbon steel because of these problems until now.

More and more new apartment buildings are including air conditioning as an essential building service right at the construction stage. This is especially true in New York City. The 30-story Imperial House, largest apartment building to be built in New York City with air conditioning incorporated during construction, will have its exterior areas cooled by fan-coil units supplied by a single 940 ton centrifugal compressor. Lewis Smith explains the reasoning behind the decisions and how the system will be operated in his article on pages 136 and 137. A two-zone (north and south) hot water heating system will serve the building during the winter.

High intensity or infrared radiant heating is the subject of the HPAC Engineering Data File on pages 139 to 154. The fundamentals of radiant heat transfer with special emphasis on the application of these heating units to space heating is presented. How to calculate radiant heat exchange, how radiant heating affects comfort sensations, and what to consider when selecting and locating the radiant heating unit are some of the topics covered.

The You'll Want to Know news reports are on pages 39 to 44. "Open for Discussion" is on pages 87 to 90, and Question of the Month is on pages 92 and 94. The Law and Your Profits presents the dangers of a faulty installation in the actual case cited on page 138.

Bob Roose

Editor, HEATING, PIPING & AIR CONDITIONING

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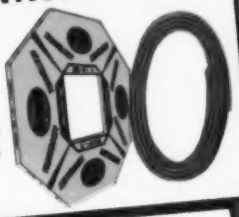

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Available from your nearby Tube Turns' Distributor. You can order TUBE-TURN Bellows Expansion Joints along with fittings and flanges from your complete-line Tube Turns' Distributor. Here is still another *plus value* you get when you specify and buy TUBE-TURN products.

*The trademarks "TUBE-TURN" and "tt" are applicable only to the quality products of Tube Turns.

Another tt *plus value from...*

TUBE TURNS

DIVISION OF CHEMETRON CORPORATION
Louisville 1, Kentucky

CHEMETRON

DISTRICT OFFICES: Atlanta • Chicago • Columbus • Dallas • Denver • Detroit Houston • Kansas City • Los Angeles • Midland • New Orleans • New York Philadelphia • San Francisco • Seattle • Tulsa
IN CANADA: TUBE TURNS OF CANADA LIMITED • Ridgetown, Ontario
DISTRICT OFFICES: Edmonton • Montreal • Toronto

MAIL FOR CATALOG. Lists available sizes of TUBE-TURN Bellows Expansion Joints . . . includes rating tables to guide in piping design. Mail coupon for free copy.

TUBE TURNS, Dept. HP-11
224 E. Broadway • Louisville 1, Kentucky

Send catalog on TUBE-TURN Bellows Expansion Joints.

Company Name _____

Company Address _____

City _____ *Zone* ____ *State* _____

Your Name _____

Position _____

Easy to apply FOAMGLAS Stay-Dry Pipe Insulation covers 18,000 lineal feet of hot and cold pipe lines in the new Norton Building, Seattle, Washington. An additional 30,000 feet of FOAMGLAS insulation was used throughout the building for refrigerated surfaces, pump coverings and as backing for Spandrelite curtain wall panels on the building's exterior. Architect: Bindon & Wright. Consulting Architects: Skidmore, Owings & Merrill. Mechanical Engineers: Bouillon, Griffith & Christofferson.

18,000 FEET OF... NEW FOAMGLAS® STAY-DRY PIPE INSULATION

won't let condensation form on these building service lines

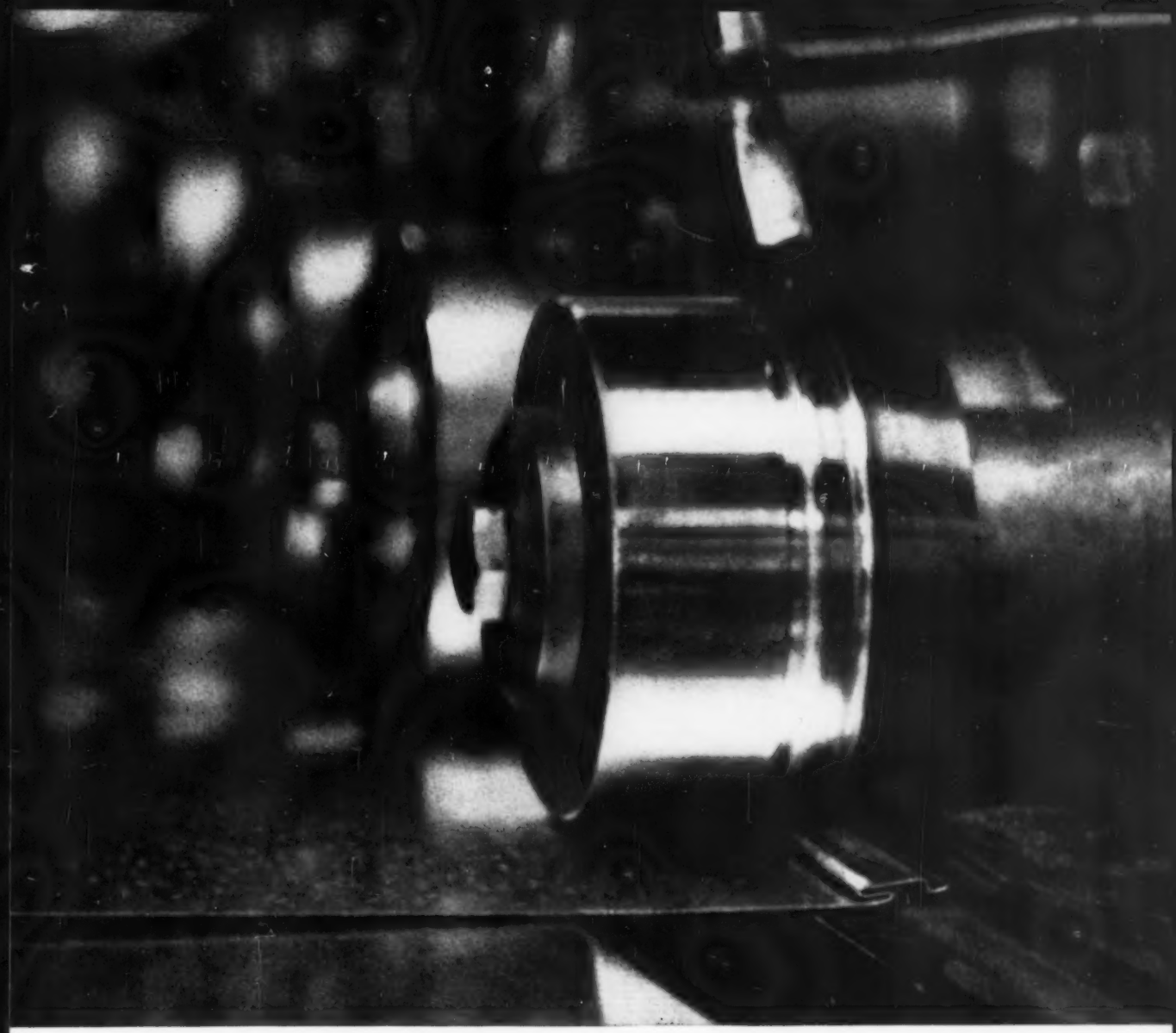
Condensed moisture on building service piping can drip down and ruin costly interior finishes and furnishings. Consulting Engineers, Bouillon, Griffith and Christofferson found an excellent, low-cost solution to this problem in Pittsburgh Corning's new FOAMGLAS Stay-Dry Pipe Insulation . . . 18,000 lineal feet of it to insulate heating and air conditioning lines in the Norton Building, Seattle, Washington.

FOAMGLAS is a natural vapor barrier . . . composed entirely of sealed glass cells. And the air inside those cells is the world's best insulator. FOAMGLAS now is available in low-cost prefabricated 24″ pipe covering segments with a kraft-foil laminate jacket for a tough protective coating and attractive white outer finish. It can be painted with water base paints.

This unique combination of benefits . . . gives you cost-saving features not found in other commercial, dual-temperature pipe insulations: Easy to apply. No additional moisture seals or cut-offs required. No vapor barrier jacket required. High compressive strength. Easy to cut and shape. Cannot burn. Waterproof. Insulating value never varies. Moisture absorption is no problem. And it is vermin-proof.

It is available in 1″ and 1½″ nominal thicknesses . . . for all lines from ½″ copper tubing through 6″ I.P.S. for service from +35°F to +350°F. For more information on new FOAMGLAS Stay-Dry Pipe Insulation, write to: Pittsburgh Corning Corporation, Dept. HP-119, One Gateway Center, Pittsburgh 22, Pa. In Canada: 3333 Cavendish Blvd., Montreal, Quebec.

PITTSBURGH PC CORNING



"LOCK SEAMS GIVE US TROUBLE? NO SIR—WE USE WEIRKOTE®!"

When it comes to the rigors of lock-seaming, nothing can take it like Weirkote.

Why? Because Weirkote combines the strength of steel with a tightly bonded continuous process zinc coating that remains intact through the severest fabricating steps. No chipping. No peeling. In fact, Weirkote can be worked to the very limits of the steel itself and still come through with a smooth, even, corrosion-resistant zinc coating on both sides of every crease.

So whether your product is crimped or drawn, spun or twisted, Weirkote means a new high in production results, corrosion prevention and customer goodwill—a new low in costly, worrisome rejects.

Weirkote's low initial price, combined with these production savings, insures the economical quality you may have been looking for. Why not investigate further by sending for the 12-page Weirkote booklet that explains how Weirkote can help you both in your products and in your production. Just write to Weirton Steel Company, Dept. M-13, Weirton, West Virginia.

WEIRTON STEEL COMPANY

WEIRTON STEEL COMPANY

WEIRTON, WEST VIRGINIA

a division of

NATIONAL STEEL CORPORATION

Specify Skidmore HEATING PUMPS

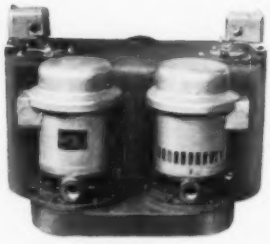
One is just right for your application

2 New Bulletins

No. 21-C

TYPE CCVS

redesigned



DUPLEX UNIT

SINGLE UNIT

Two outstanding vertical type pumps shown at right are fully described in the new Bulletin 21-C. Combining the latest features of centrifugal pump design — the New "CCVS" Pump is built in three single sizes and the duplex unit in either the two float switch or automatic alternator type.

Send for Bulletin No. 14-B

TYPE HS

The economy HS Pump is especially well constructed with stainless steel shaft and bronze-fitted throughout. New capacities of the SKIDMORE HS Pump range from 1,000 to 125,000 sq. ft. E.D.R. with discharge pressures from 10 to 75 lbs. Pump is built in both single or duplex unit, and is mounted on steel base or cast iron if desired. Write for complete engineering data on this or other pumps.

Sales Representatives in Principal Cities

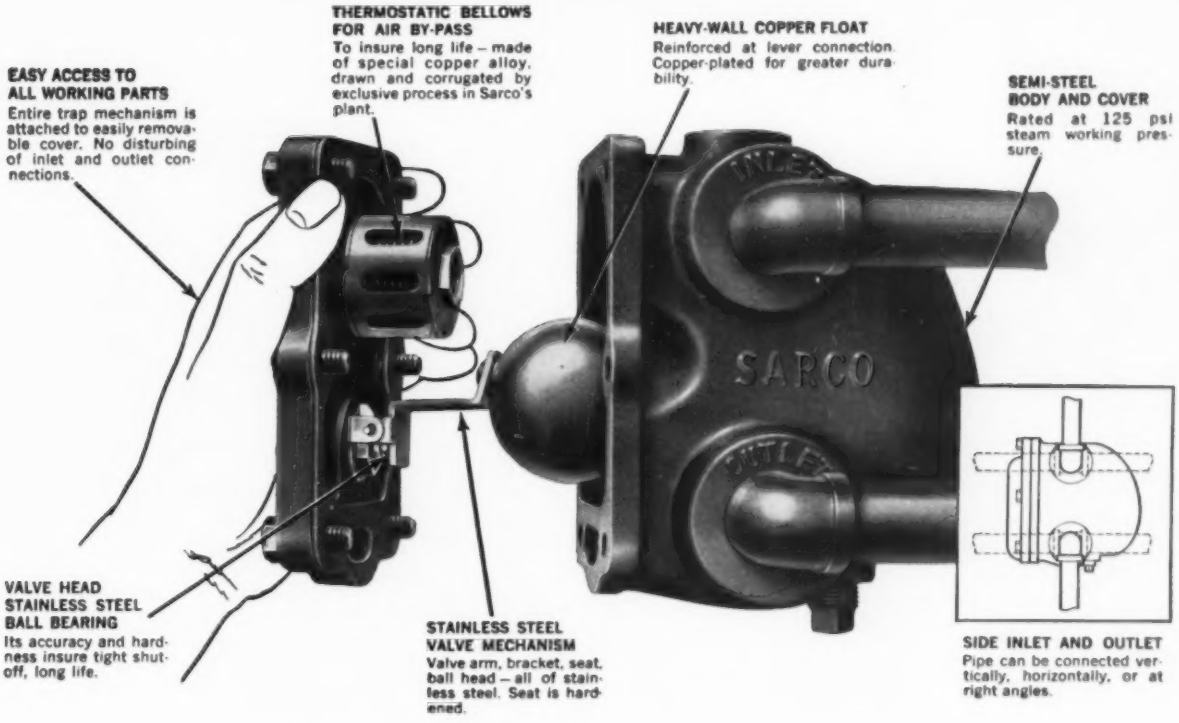
SKIDMORE PUMPS

SKIDMORE CORPORATION ST. JOSEPH MICHIGAN

Now...more trapping value for your money!

NEW SARCO FLOAT-THERMOSTATIC STEAM TRAP

with improved engineering features


EASY ACCESS TO ALL WORKING PARTS
Entire trap mechanism is attached to easily removable cover. No disturbing of inlet and outlet connections.
THERMOSTATIC BELLOWS FOR AIR BY-PASS
To insure long life – made of special copper alloy, drawn and corrugated by exclusive process in Sarco's plant.
HEAVY-WALL COPPER FLOAT
Reinforced at lever connection. Copper-plated for greater durability.
SEMI-STEEL BODY AND COVER
Rated at 125 psi steam working pressure.
SARCO
VALVE HEAD STAINLESS STEEL BALL BEARING
Its accuracy and hardness insure tight shut-off, long life.
STAINLESS STEEL VALVE MECHANISM
Valve arm, bracket, seat, ball head – all of stainless steel. Seat is hardened.
SIDE INLET AND OUTLET
Pipe can be connected vertically, horizontally, or at right angles.

This new, improved Sarco Float-Thermostatic Steam Trap Type FT discharges condensate at steam temperature continuously and without shock.

Recommended to drip steam mains, unit heaters, blast coils, heat exchangers, and other allied process equipment, requiring accurate temperature control.

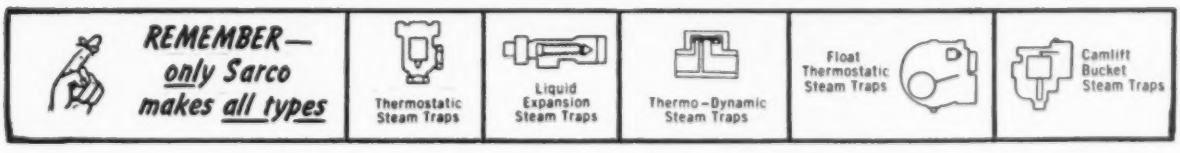
Air Binding Impossible – equipped with separate thermostatic air vent, which removes automatically and immediately all air and incondensable gases reaching trap. Balanced pressure vent self-adjusts to all operating pressures. Its location above condensate level permits discharge of air and gases reaching trap after start-up. Does not require adjustment when pressures change.

Sizes – ¾ and 1"
For steam pressures – 0 to 125 psi

Write for Bulletin 455-B **to Sarco Company Inc., 635 Madison Avenue, New York 22, N.Y.**

22108

SARCO

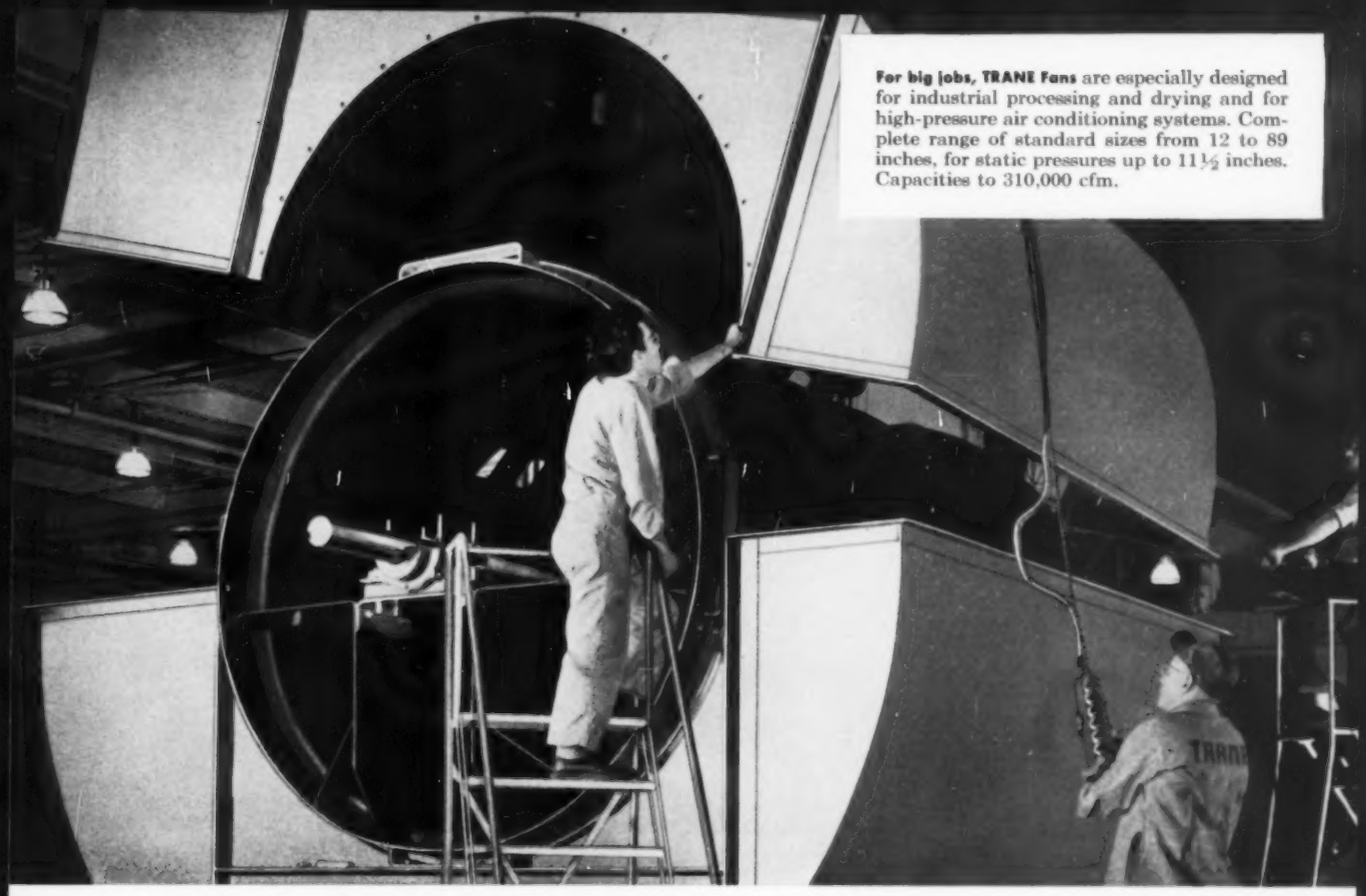


O-B VALVES

easy gate valve maintenance starts here. . .

O-B Union Bonnet Gate Valves are designed to meet industry's need for valves that are easy to maintain. They can be broken for inspection and servicing, then quickly and accurately reassembled. Each time the union ring is pulled down it makes a leaktight joint. Body and bonnet mating surfaces come together in a tight seal that cannot become loosened during ordinary operation. The union ring also adds strength at the bonnet joint, keeping internal pressures from spreading the body neck.

Number 9100 and 9300 rising stem valves are made of quality bronze in ¼" thru 3" sizes. Ask your distributor about these and other O-B valves, or write to Ohio Brass Company, 380 North Main Street, Mansfield, Ohio.



For big jobs, TRANE Fans are especially designed for industrial processing and drying and for high-pressure air conditioning systems. Complete range of standard sizes from 12 to 89 inches, for static pressures up to 11½ inches. Capacities to 310,000 cfm.

Choose a dependable Trane Fan for any process or comfort job!

Accurate ratings, rugged construction assure quiet, efficient operation

The fans you choose for your air-moving jobs—process or ventilation—may mean the difference between top performance and inadequate performance. That's why leading consulting engineers turn to TRANE for fans that are designed for quiet, efficient operation . . . simplified installation and maintenance—and available in a complete range of capacities and types to handle any job.

TRANE Fans are *accurately rated* and ruggedly built. Solid workmanship and the most modern tooling assure consistently dependable performance. And each TRANE Fan design has been tested and approved in the industry's most modern and complete testing laboratories.

TRANE gives you a single, reliable source for *all* your air moving jobs: giant Class I, II and III fans . . . Cabinet Fans . . . Utility Fans—all tested under the AMCA and ASHAE Code. TRANE field personnel in 97 offices are available to help you make the best selection for any air moving job.

When you need a rugged, dependable fan for human comfort or industrial process, turn to TRANE. See your nearby TRANE Sales Office, or write TRANE, La Crosse, Wisconsin.

WANT MORE FACTS? Write on your letterhead for Bulletins: FC Fans, Class I and II (DS-348-F); BI Fans, Class I and II (DS-348-B); BI Fans, Class III (DS-348-C); Utility Fans, (DS-348-U). Cabinet Fans, (DS-348-D). Axial Roof Ventilators, (DS-364-A). Centrifugal Roof Ventilator, (DS-364-C).

For any air condition, turn to

TRANE

MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS. • SCRANTON MFG. DIV., SCRANTON, PA. • CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN. • TRANE COMPANY OF CANADA, LIMITED, TORONTO • 97 U.S. AND 19 CANADIAN OFFICES

FOR ROOF APPLICATIONS new TRANE axial flow and centrifugal roof ventilators are especially designed for low silhouette, efficient air movement. Complete range of sizes and models.

PACKAGED UTILITY FANS for fast, economical installation for hundreds of plant ventilating jobs. Exceptionally smooth and quiet in operation. Capacities to 15,450 cfm.

Designed to give you *Double Protection!*

WAGNER TYPE DP MOTORS

PROTECTED against corrosion...

PROTECTED against splashing liquids...

WM59-9

Wagner Type DP Motors provide *double protection* that means longer life—more versatility of application. Rugged cast iron frames and endplates are highly resistant to corrosion. Dripproof enclosures are so well designed that these motors can handle many applications that formerly required splashproof motors. These motors pack ample power into little space, are light in weight and are easy to maintain.

SLEEVE BEARING MODELS AVAILABLE. The entire line of ratings is available with ball bearing construction, or with steel-backed, babbitt-lined sleeve bearings of high load carrying capacity that provide quieter operation.

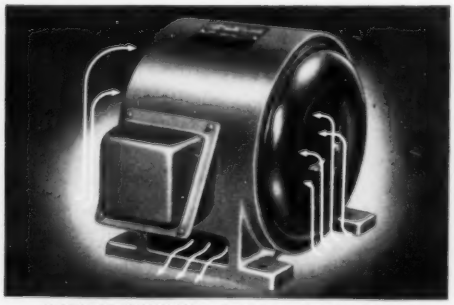
Let a Wagner Sales Engineer show you how these motors can be applied to your needs. Call the nearest branch office or write for Wagner Bulletin MU-223.

Branches and Distributors in All Principal Cities

Wagner Electric Corporation

6370 Plymouth Ave. • St. Louis 14, Missouri

DOUBLY PROTECTED—Air intakes and outlets are positioned to provide complete protection against dripping or splashing liquids. Rugged cast iron frames protect against rough handling and corrosion.



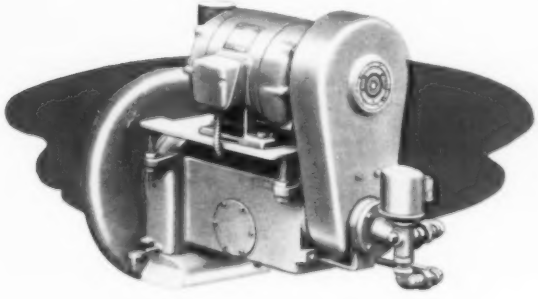
COOLING RUNNING—Specially designed baffles, which protect the stator windings, direct a cooling stream of air through the motor to effectively cool the motor—add to motor life.

CAN BE RE-LUBRICATED—Original factory lubrication will last for years in normal service—but grease plugs are provided to permit re-lubrication that adds years to motor life under severe conditions.

ALL PACKAGED BOILERS ARE NOT THE SAME

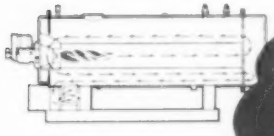
IS IT A TRUE PACKAGE?

Superior Packaged Boilers are complete . . . including burner, draft equipment, controls and all interconnecting piping and wiring. Completely factory assembled, and fire-tested at the factory before shipment.



IS IT ROTARY-BURNER EQUIPPED?

This is important for fully-automatic operation. The Superior Burner is capable of starting a cold boiler without compressed air, requires a minimum of supervision, and no lubrication whatsoever.



4-pass design 5-square feet

IS ITS HEATING SURFACE ADEQUATE?

Most boilers have adequate heating surface when new. Its effectiveness is lessened, however, as the boiler is used. To insure against this, look for a full five square ft. per boiler horsepower, and Superior's 4-pass, down-draft design.

CHECK THESE IMPORTANT FEATURES

before you buy...

There's a big difference in package boilers, that is not always obvious from external appearances. In the first place, many of the so-called packages are not packages at all, but combinations of boiler on the one hand and a burner-draft-control package on the other, shipped from separate manufacturers and assembled as a unit at the installation site.

Even in the true packages there are important differences in burner equipment, draft arrangements, and in the actual rating of the boiler itself.

Superior Packaged boilers are true packages, fully assembled and fire-tested at the factory before shipment. They are equipped with dependable Superior Rotary Burners, induced draft, integrated controls, and all interconnecting piping and wiring. They are conservatively rated, based on a full 5 sq. ft. of heating surface per boiler horsepower.

The location of the furnace within the boiler shell is carefully planned to provide protection against both low-water and mud-buildup failures.

Ask your engineer about Superior Packaged Boilers, his counsel is your best assurance of a boiler which will provide years of dependable operation at high efficiencies.

Type C Superior Packaged Boilers are manufactured in fourteen sizes, from 20 to 350 bhp., and with slight design modifications to 600 bhp. Sizes above 350 bhp. are designated as Type CF. All sizes are fully automatic firing oil, gas or both, and for pressures to 250 psi. Hot water units are also available. For complete information write giving capacity range desired, and ask for bulletin 14C.

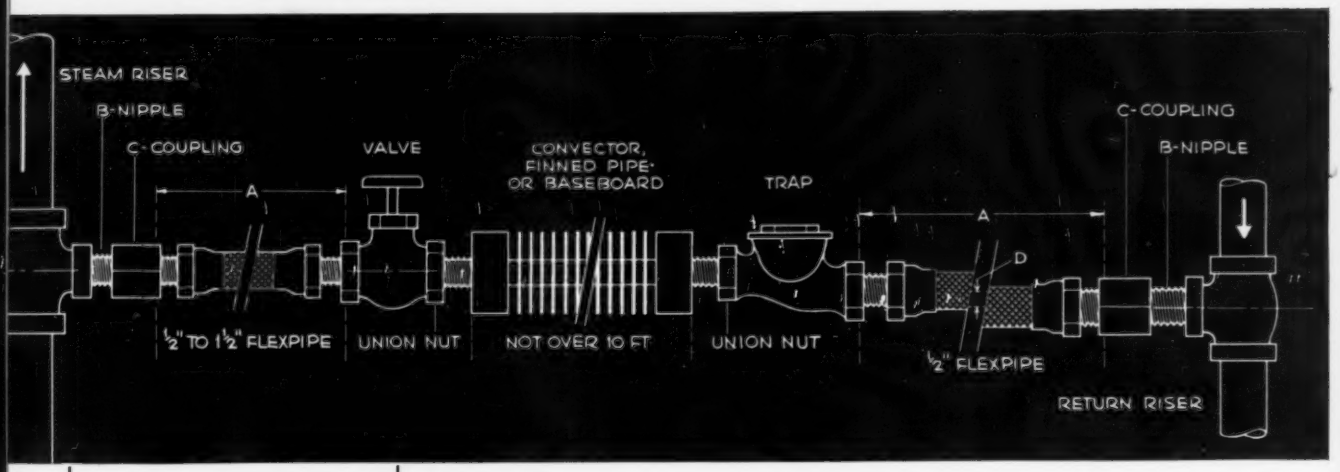
Specialists in PACKAGED BOILERS... exclusively

SUPERIOR COMBUSTION INDUSTRIES, INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR PACKAGED BOILERS

APPLICATION HINTS:

Ways to simplify construction and cut costs with Flexpipe



DIMENSIONS

I. D.	A	D (max.)
½"	10"	½"
½"	20"	1¼"
¾"	11"	½"
¾"	22"	1¼"
1"	12"	½"
1"	24"	1¼"
1¼"	13"	½"
1¼"	26"	1¼"
1½"	14"	½"
1½"	28"	1¼"

NOTES:

Flexpipes will take care of vertical movement and permit easy alignment of piping without straining trap, valve bodies or heating elements and causing leaks.

Offset "D" is shown for location above riser anchor only. Install with this offset to avoid trapping condensate. Offset shown is maximum—not to be exceeded when installed cold. Select length "A" according to riser expansion expected.

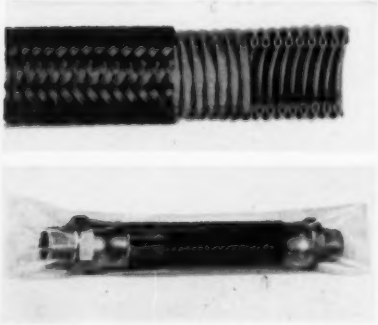
Nipple "B" and coupling "C" may not be needed in some cases. When center lines of risers and heating elements are not in the same plane, turn the riser tees 45 or 90 degrees and use elbows and nipples as required.

Select valve and trap body pattern as required for the job.

Sweat fittings furnished when needed.

Streamlining a steam heating system with flexible connectors

To conserve space, simplify installation, and provide greater reliability, the use of Flexpipe flexible connectors to streamline heating systems is becoming more important.



FLEXPIPE has core of seamless tin bronze tubing corrugated for flexibility. No packing. 100% tight. Tin bronze wire braid covering for extra strength. Brass fittings attached. Packaged in clear, tough polyethylene bag for easy identification, handling and warehousing.

In the simplified steam system using convectors, finned pipe, or baseboard radiation, shown above, for example, Flexpipes will solve many problems. They eliminate three elbow swing connections to compensate for expansion and contraction in the risers. The piping can hug the wall—there's no need to go through the floor to make connections from the floor below. There are fewer connections, fewer possible leaks. There is no strain on trap and valve bodies or on the heating elements. Flexpipes help make possible a system that will operate dependably through the years with little maintenance.

IN HOT WATER SYSTEMS, Flexpipes can help do a similar streamlining job. The trap is replaced by a balancing elbow and an air valve.

WHERE TO BUY. Flexpipe connectors come in convenient standard sizes from ¼ inch through 2 inch, and are sold by leading distributors. They can show you samples and answer questions about service applications. For the name and address of the one serving your area, or for more detailed information, write to: Anaconda Metal Hose Division, The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass, Ltd., New Toronto, Ont.

Flexpipe® an ANACONDA® product

MUNDET

Choose the BEST for Your Purpose...

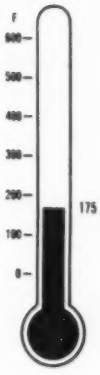
MUNDET ENGINEERED INSULATIONS Include:

85% MAGNESIA

Mundet "Custom-Molded" 85% Magnesia is available in board and pipe covering. 85% Magnesia is the standard for highest efficiency on temperatures up to 550°F; assures low conductivity; is stable and easily applied. One of the best known insulations for industrial needs for half a century. For temperatures above 550°F, use Mundet "Tri-calite" insulation.

GLASS FIBER

Mundet glass fiber products include Superfine Glass Fiber blanket insulation, Superglas pipe insulation with patented "hinge action," and Supertex Glass Fiber duct liner. This modern low-density insulation is recommended where maximum thermal and acoustical efficiency is required for minimum space, on applications up to 350°F. Easily handled, clean and sanitary.



POLYSTYRENE

Mundet Expanded Polystyrene Board and Pipe Covering provide extremely low conductivity; highest resistance to vapor transmission and moisture absorption. This material has exceptional compressive strength; is odorless, lightweight and durable. Manufacturing control assures precision fit. Applications include refrigerant piping, duct work and cold storage rooms.

CORK

From sub-zero to +35°F, Mundet Cork insulation offers the "heavy-duty" protection that has never been surpassed. Mundet Corkboard and Cork Pipe Covering are fabricated from 100% pure Cork to the most exacting specifications . . . is the highest grade cork insulation obtainable. Recommended for all low temperature applications on its record of proved use.

Write for free Data Bulletins on any of our products. In addition to a full line of insulating materials Mundet provides expert contract installation services through our branch offices or through Mundet distributor-applicators located in most industrial areas. If you are interested in controlled temperatures at lowest cost and minimum maintenance, call on us now.

MUNDET CORK CORPORATION

Insulation Division: 7101 Tonnelle Avenue, North Bergen, New Jersey

ATLANTA
339-41 Elizabeth St. N. E.

CHICAGO
35 E. Wacker Dr.

CINCINNATI 25
3118-24 Spring Grove Ave.

DETROIT 38
14401 Prairie Ave.

HOUSTON 11
6601 Supply Row

JACKSONVILLE 2, FLA.
514 E. Bay St.

LOS ANGELES
(Maywood), 6116 Walker Ave.

PHILADELPHIA 30
856 N. 48th St.

PORTLAND, ORE.
2435 N. Lombard St.

ST. LOUIS 38
3176 Brannon Ave.

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SAN FRANCISCO 7
440 Brannan St.

NEW YORK 17
331 Madison Ave.

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Buffalo 2, New York

E. J. Eddy, Inc.
1040 Jay Street
Rochester 11, New York

BEFORE YOU BUY, THINK:

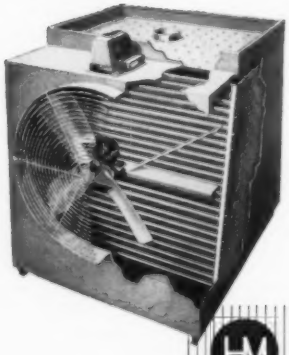
Will fungus attack your cooling tower 2 years from now?

Not if it's a Halstead & Mitchell cooling tower with a 20-Year Guarantee

The specially treated wood decking in H&M towers resists rotting, fungus attack and algae which accumulates and obstructs air flow in most other towers. Performance remains "like new" in H&M cooling towers year after year.

Only Halstead & Mitchell offers a 20-Year Guarantee on the wetted deck against failure due to rotting or fungus attack.

Other H&M features for unusually low maintenance include permanently sealed fan bearings, and a heavy gauge steel cabinet protected against corrosion by three plastic coats applied *after assembly*. Be sure. Ask your local wholesaler for H & M towers, or write to Halstead & Mitchell, Bessemer Building, Pittsburgh 22, Pa.



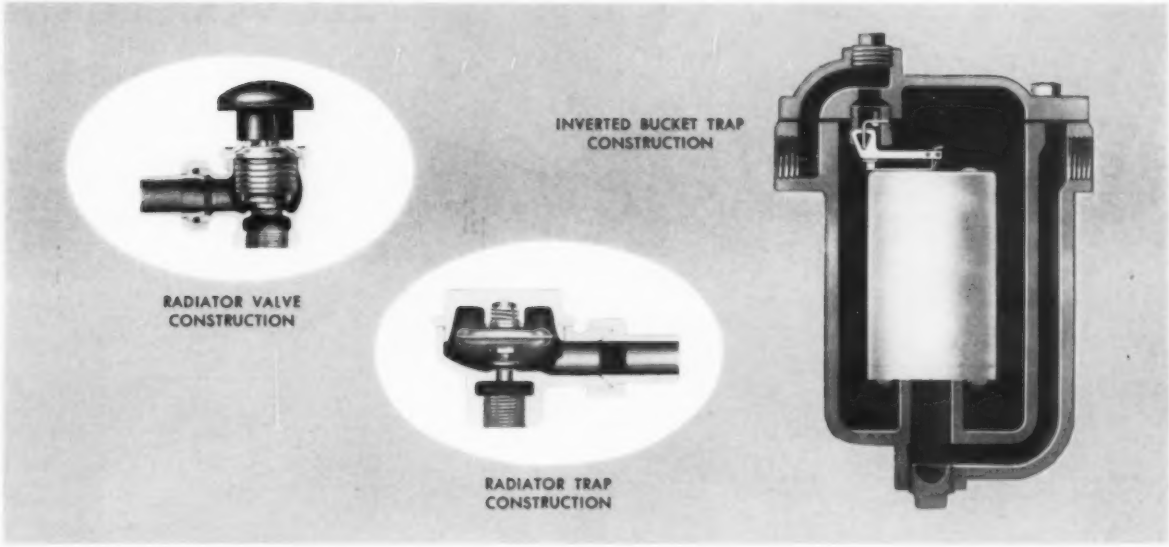
H & M COOLING TOWER WITH PRESSURE TREATED DECKING

HM

Halstead & Mitchell

Water-Cooled Condensers · Cooling Towers · Air-Cooled Condensers · Finned Coil Products

25″ Vacuum to 150 lbs. Pressure . . .
You'll Find it in DUNHAM-BUSH
Steam Heating Specialties



It's a hefty jump from 25″ vacuum to 150 lbs. pressure. But it gives you an idea of the complete scope of quality Dunham-Bush Steam Heating Specialties.

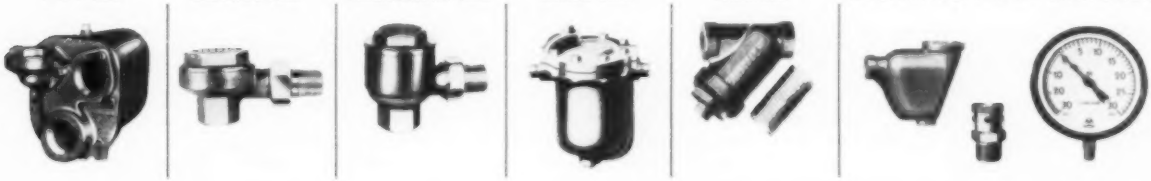
Name a steam heating specialty and Dunham-Bush has it!

You know steam heating specialties, but do you know the advantages of dealing with "one source—one responsibility"... Dunham-Bush?

If not, it'll pay you to write for free brochure #1501 and/or the name of your nearest Dunham-Bush sales engineer.

PART OF THE DUNHAM-BUSH LINE . . .

F & T TRAP | RADIATOR TRAP | THERMOSTATIC TRAP | BUCKET TRAP | STRAINERS | AIR ELIMINATOR AND AIR CHECK GAUGES

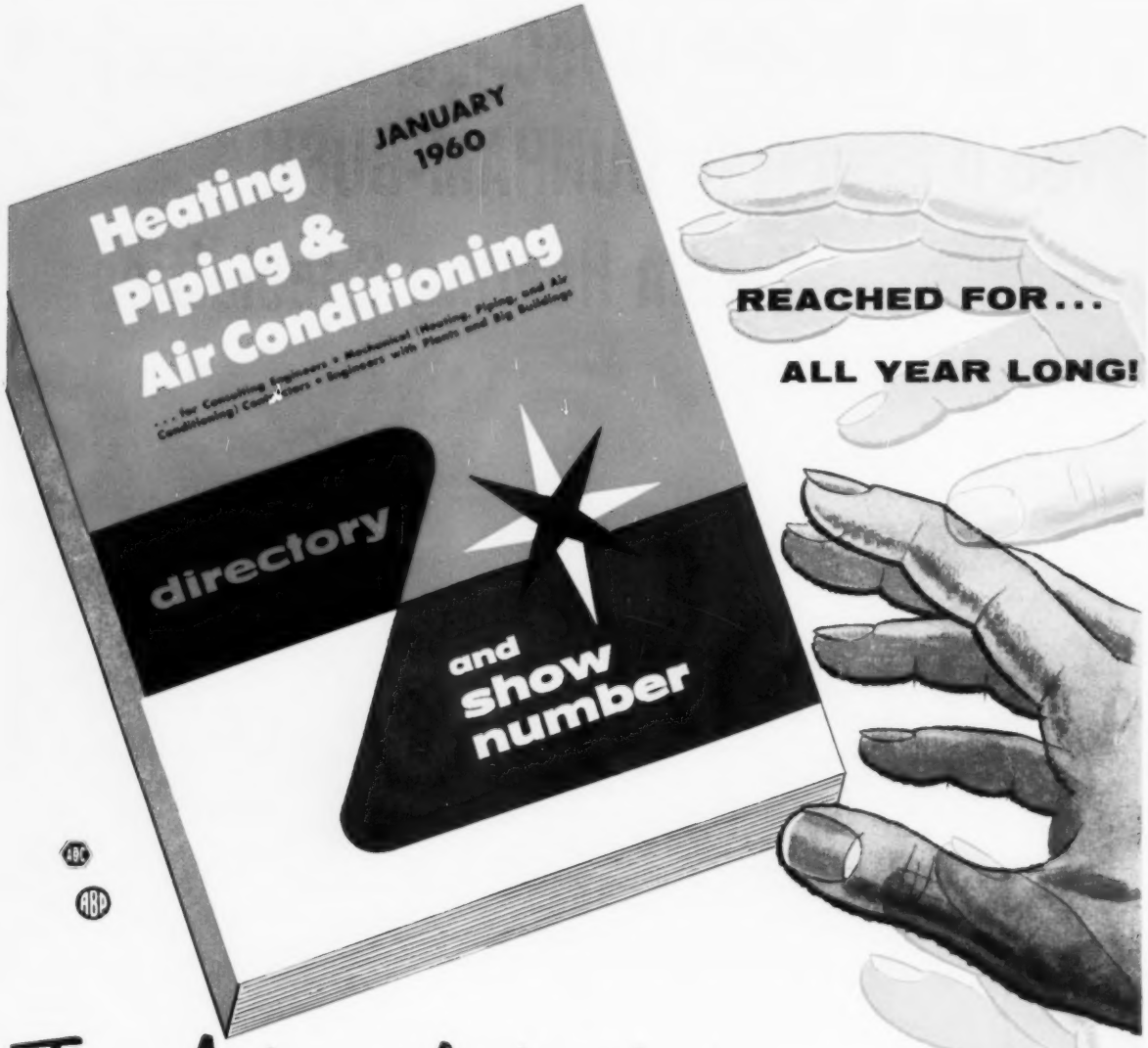


Dunham-Bush, Inc.

WEST HARTFORD 10 • CONNECTICUT • U. S. A.

DUNHAM-BUSH

AIR CONDITIONING • REFRIGERATION • HEATING • HEAT TRANSFER



The Acknowledged...

BUYING / SPECIFYING GUIDE since 1934

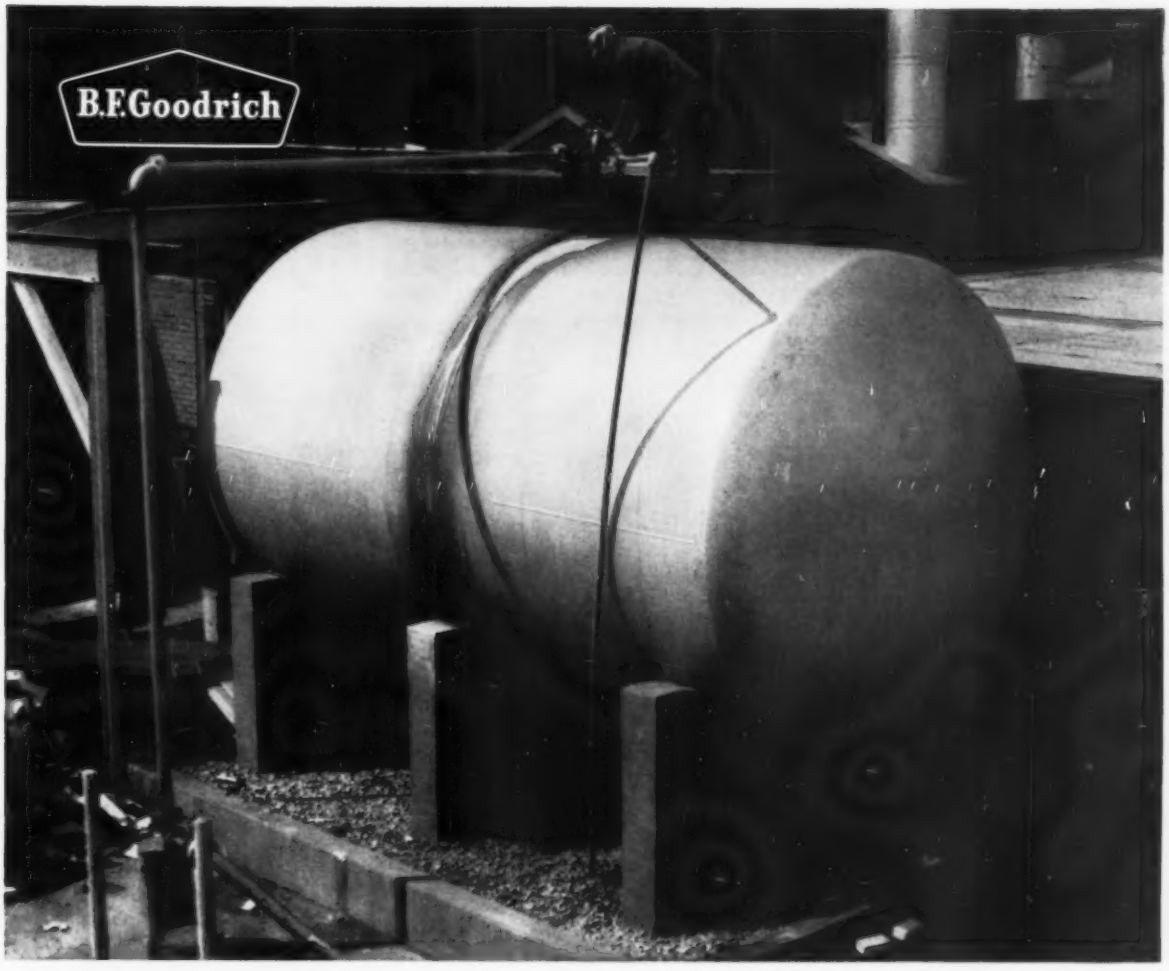
"WHO MAKES IT?" "WHERE CAN WE GET IT?" When an engineer or contractor in the industrial-large building field is ready to buy or specify your type of product, here's where he goes. He repeatedly uses HEATING, PIPING & AIR CONDITIONING's January Directory Number to identify sources of supply and learn specific details about products.

Here's proof: In a survey of our *all paid* subscribers, 96% report they keep this field-specialized Directory throughout the year, 75% refer to the advertising pages as they use the Directory, and 91% regard the Directory as useful to them.

Lasting sales power plus immediate cover-to-cover attention! Nearly 300 advertisers appear each year! Not a 13th or extra-cost issue — regular space rates apply! Start off 1960 right . . . tell your full story, parade your entire line in this value-packed issue. Closing date, December 10. KEENEY PUBLISHING COMPANY, 6 N. Michigan Ave., Chicago 2, Ill.

LOOK WHAT THIS DIRECTORY CONTAINS:

1. An alphabetical listing of all products used in the field, and manufacturers of each.
2. Names and addresses of all these manufacturers.
3. A listing of all known trade names with the product and manufacturer identified for each.
4. All products advertised in this issue are classified and listed. This guides readers to the ad pages where they'll find more information on what they seek.
5. Normal editorial content of a regular issue assures immediate cover-to-cover attention.
6. A COMPLETE SHOW SECTION previewing the 2nd Southwest Heating and Air Conditioning Exposition in Dallas Feb. 1-4.



How Koroseal saves $12,000 a year for L. A. Darling Company

THE L. A. Darling Company of Bronson, Michigan manufactures plated racks and other display equipment for retail stores. Manual handling of muriatic acid in carboys (glass containers) was an expensive part of the manufacturing cost.

Then, three years ago, Darling installed a 12,000-gallon Koroseal-lined tank (pictured above) and a network of rigid Koroseal PVC piping. The tank permitted bulk purchase of acid, and the piping eliminated manual handling. Tangible savings have been in excess of $12,000 each year. And further savings have been realized through the elimination of broken carboys and the release of working capital previously tied up in deposits on carboys.

Koroseal rigid PVC by B.F. Goodrich has answered countless problems for alert manufacturers. Koroseal is unaffected by most alkalies and acids and is completely inert in the presence of oil, alcohol and salt solutions. It resists corrosion, has superior insulation qualities, will not support combustion and never needs to be painted.

Easy to install, Koroseal in various forms can be threaded, cut, welded or drilled. It is available in pipe, tubes, rods, valves and sheets. For information, just send in the coupon.

B.F.Goodrich Industrial Products Co.
Dept. HP-11, Marietta, Ohio

Please send me free booklets on:

☐ Rigid Koroseal Pipe
☐ Rigid Koroseal Sheet

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Koroseal—T. M. Reg. U. S. Pat. Off.

B.F.Goodrich *Koroseal rigid PVC products*

"Engineered for air conditioning systems"

ACF® Plug Valves

Here's the ideal valve for air conditioning and heating systems — the ACF lubricated Plug Valve. It provides maximum control with minimum cost for air handlers, compressing units, water lines, natural gas or fuel oil lines, and water towers.

Tight Seal, Full Pipe Area

A Teflon gasket backed-up by a lubricant reservoir seals the head seat. The cylindrical plug — no taper to bind and stick — provides an effective seal in the line. A smooth, well-proportioned full pipe area port opening minimizes turbulence and pressure drop.

Always Easy to Operate

No matter how long between operations, ACF Plug Valves open and close easily. All friction surfaces are constantly lubricated for smooth turning and protection against corrosion. Quick, quarter-turn movement of wrench opens or closes valve. Auxiliary packing is not required—only small amounts of lubricant for initial charge and periodic servicing are necessary.

Dial Indicator Marks Balanced Position

All ACF Plug Valves may be equipped with dial indicators for obtaining or recovering proper balance in any air conditioning system. This simple and inexpensive gauge can save a great deal of time, money and inconvenience.

Write for the facts — and the name of your distributor — **today.**

For specifications on *"ACF lubricated Plug Valves for Air Conditioning and Heating Systems"* . . .

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DIVISION OF ACF INDUSTRIES INCORPORATED

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THE BIG ONES COME TO BURNHAM

Stewart House Apartments—New York City
Diesel Construction Co., Inc., N. Y. C. . . *Builder and General Contractor*
Sylvan and Robert Bien, New York City . . . . . *Architects*
Sears and Kopf, New York City . . . . . *Consulting Engineers*
J. E. Schecter Corp., New York City . . . . . *Heating Contractor*

NEW LUXURY APARTMENTS TO HEAT WITH BURNHAM COMPACT-TYPE STEEL BOILERS

Filling an entire city block, Stewart House is one of the largest fine apartment buildings going up in New York City this year. A luxury co-op, it stresses quality throughout. To provide maximum heating capacity in minimum floor space, Burnham Compact-Type Steel Boilers were chosen. Three boilers will be used, each with a capacity of 38,750 sq. ft. E.D.R. normal steam, new S.B.I. rating. Burnham's Compact-Type Welded Steel Boilers are available in new S.B.I. ratings from 2,930 to 39,370 sq. ft. net E.D.R. steam, with comparable ratings for water. Specify them on your next job where space-saving and quality are important.

Burnham also offers a complete line of Scotch-Type and Scotch-Type Package Boilers in the above ratings and in certified ratings with up to 4,000 sq. ft. of heating surface.

Burnham Corporation

Steel Boiler Department
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Please send me, without obligation, full ratings and data on:
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Address .....

City ..... State .....

1000 TON CAPACITY PLANT

...air conditions Des Moines newspaper building. 375,000 c.f.m. air circulation!

AIR CONDITIONING MILESTONE

DES MOINES—The combination 13- and 4-story Register-Tribune building is the only large newspaper publishing plant to be successfully air conditioned throughout from a single air handling unit.

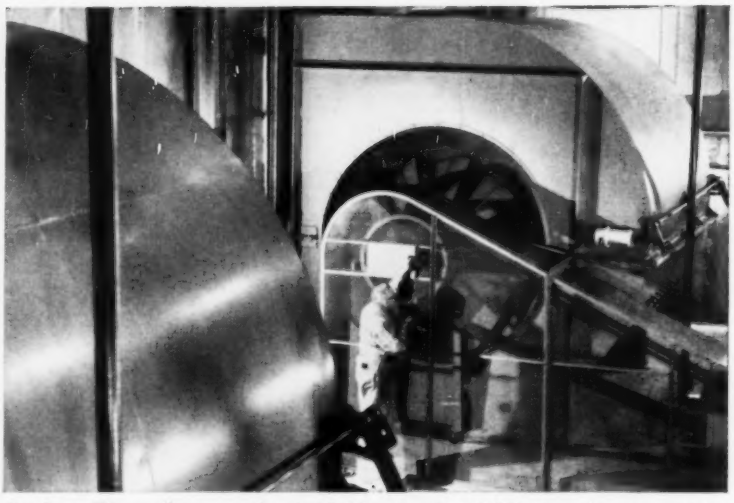
WIDE TEMPERATURE RANGE

In addition to fitting duct work into an almost impossible structural situation, the engineer was faced with widely varying room temperatures that result from the amazing variety of operations performed in a newspaper plant. Under one roof and in close proximity are hot stereoptyping operations, typesetting, darkroom facilities, wire service functions as well as office areas where humans work feverishly to satisfy the news demands of ever-humming, ever-hungry printing presses.

CHICAGO BLOWERS CIRCULATE 375,000 C.F.M. OF AIR THROUGH 1½ MILLION CUBIC FT. AREA

"One of the toughest problems," according to Mr. Wm. E. Nanes, consulting engineer, "was the cool air circulating fans."

"The Register-Tribune people specifically requested the quietest fans available. It turned out that Chicago Blower Corporation could meet our needs on both counts. They had the capacity we wanted and their special hollow-sectioned air foil blade construction made the fans surprisingly quiet."



Two huge Chicago Blower centrifugal airfoil fans handle 375,000 c.f.m. of air in supplying cool, conditioned air throughout the newspaper plant and office areas. Special "Chicago" aerodynamic fan blade design keeps noise level at an absolute minimum.

92% EFFICIENCY WITH LESS POWER

Two Chicago Blower fans, whose housings are 15′ high, were used. Each fan rotor is over 7′ in diameter and weighs 3000 pounds. Because the blades are aerodynamically designed, similar to an airplane wing, eddy currents responsible for turbulence and noise are virtually eliminated. Fan efficiencies are an amazing 92% and they operate on less power. Noise level over similar capacity units is reduced as much as 40%.

CHICAGO BLOWER ENGINEERING ASSISTANCE ALWAYS AVAILABLE

Chicago Blower plant and field engineers are always on call to assist firms working on heating and ventilating problems. They bring to any job a wealth of time-, trouble-, and money-saving information gained on thousands of installations.

CHICAGO

CHICAGO BLOWER CORPORATION

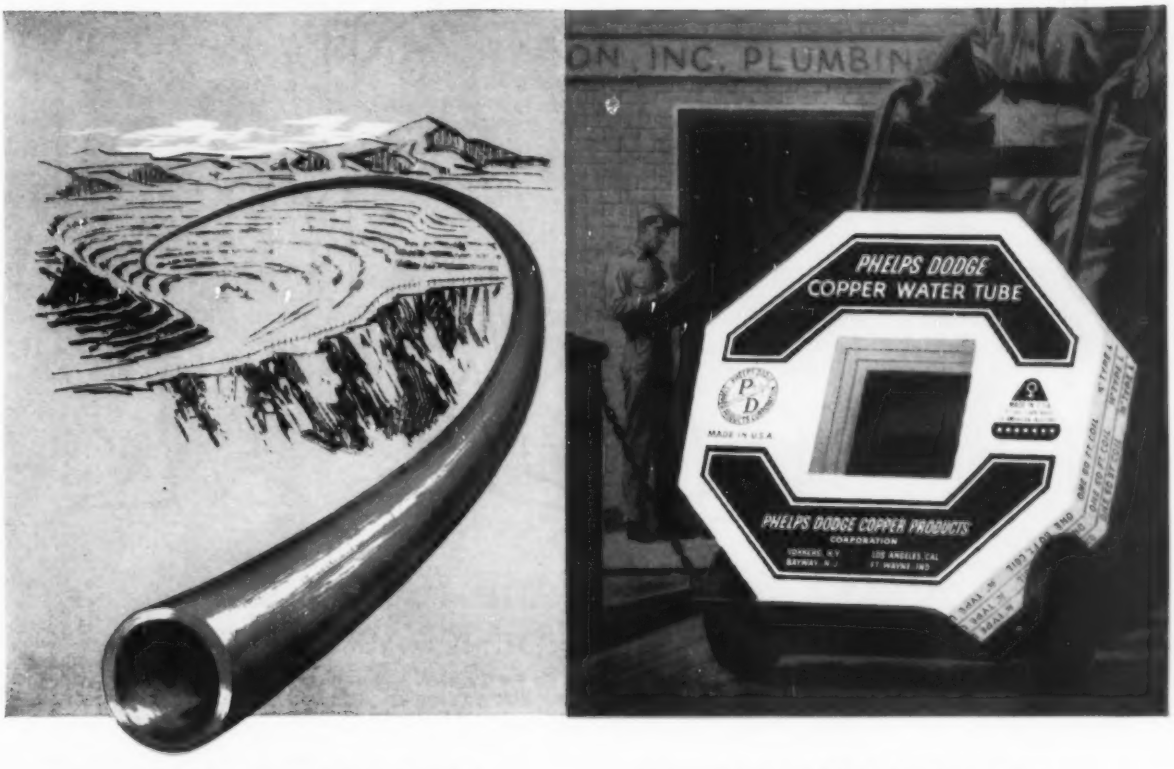
9869 Pacific Avenue • Franklin Park, Illinois •

Your local Chicago Field Engineer is in the 'Yellow Pages'

Want all the facts about this aerodynamically-designed fan? Ask your "Chicago" field engineer for a copy of Bulletin A-103. You will find him listed under "Fans," "Blowers," or "Ventilating Equipment and Supplies" in the YELLOW PAGES of your phone book. If you prefer, write or call direct and complete information and service will be provided.

TWO IMPORTANT REASONS FOR SPECIFYING . . .

Phelps Dodge Copper Water Tube



Famous Mine-to-Market Quality that means Dependability

Phelps Dodge copper water tube's outstanding reputation for superior quality is the result of complete Phelps Dodge control of materials and manufacturing methods, from the mining operation to the finished product. Phelps Dodge water tube is made of the highest grade copper from Phelps Dodge's own mines . . . is carefully controlled for quality throughout fabrication . . . and has unsurpassed tube properties, including precise uniformity of wall thickness, due to Phelps Dodge's unique Hot Forged-Extrusion Process.

Dependable Distributors with Complete Service Facilities

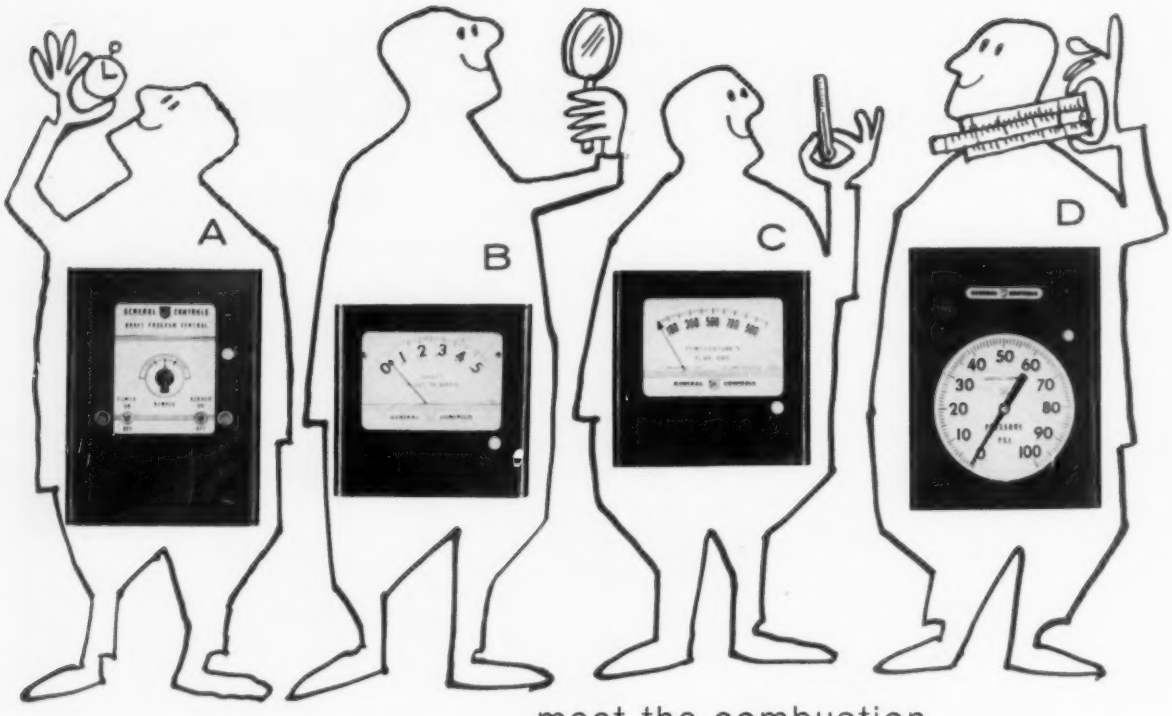
Phelps Dodge distributors can supply plumbing and heating contractors from complete stocks of pipe, copper water tube, copper drainage tube, copper refrigeration tube and other essential plumbing equipment of all kinds . . . everything needed for home building, industrial expansion, heating and air conditioning and factory maintenance. Phelps Dodge distributors also offer expert advice and valuable job tips, plus practical knowledge from Phelps Dodge representatives that help to solve on-the-job problems.

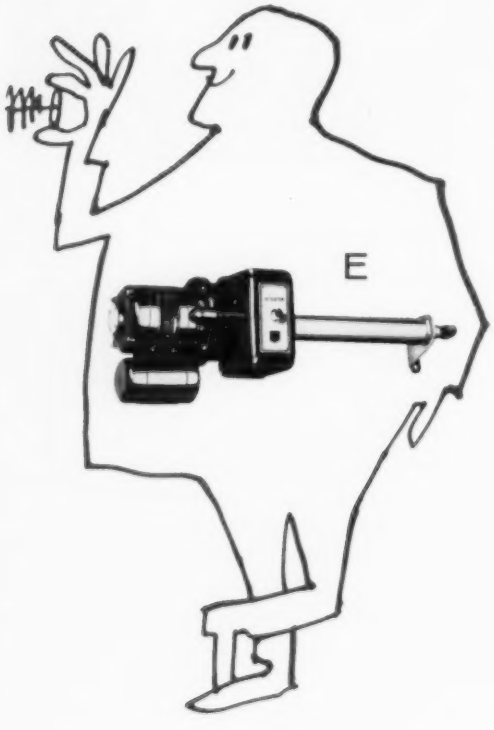
Your Phelps Dodge distributor has the best of everything: top-quality products and friendly service!

PHELPS DODGE COPPER PRODUCTS CORPORATION

NEW YORK, N. Y. • LOS ANGELES, CALIF.

MADE IN U.S.A. TO THE STANDARDS OF AMERICAN INDUSTRY





meet the combustion

EFFICIENCY EXPERTS

from GENERAL CONTROLS

Wondering how to step up your boiler efficiency, cut down on costs? General Controls puts a real damper on fuel waste... with a draft control system that pays for itself again and again.

It's the system that goes in easily, inexpensively—with any type boiler, any type fuel. Saves you as much as 25% on fuel. Saves on manpower, too!

You'd better get acquainted with our panel of efficiency experts:

A **DRAFT PROGRAM CONTROL:** Start-up, shut-down, measures draft changes and sets damper for any firing rate. Optional safety feature shuts down boiler when draft condition is unsafe. Fast, accurate... senses atmospheric changes.

B **DRAFT INDICATOR:** Provides continuous visual readings of draft conditions in combustion chamber and/or stack.

C **FLUE GAS TEMPERATURE INDICATOR:** Shows boiler efficiency by indicating excessive heat loss.

D **STEAM PRESSURE INDICATING CONTROLLER:** Indicates boiler pressure on main instrument panel, and gives accurate on-off or proportioning control.

E **ACTUATOR:** Operates stack damper to maintain constant combustion chamber draft.

Call in the GENERAL CONTROLS MAN in your area today to work out a draft control system for your plant. Or get all the facts by return mail from

GENERAL CONTROLS

Automatic Controls for Product or Process

Glendale, Calif. • Skokie, Ill. • Guelph, Ontario, Canada

Nine Plants — 44 factory branch offices serving the United States, Canada and Western Europe

insist on...

Genuine RIDGID.

THE RIDGE TOOL COMPANY, ELYRIA, OHIO, U.S.A.

Now—a new appearance concept for low-budget commercial installations

The "Power-Plant" Look

with Johns-Manville FIBROCEL Insulation!

Now you can bring the traditionally fine appearance and performance excellence of your power plant work to general commercial and industrial installations... with Johns-Manville Fibrocel® Insulation!

Why these power plant advantages? Simply because Fibrocel is molded! The only commercial insulation made (by a precision metal mold) to near-perfect roundness, with unmatched uniformity of size and line.

This means an immediate end to costly finishing, heavy jacketing, needless pointing up of cracks and apertures. Instead, Fibrocel gives you a tighter, better looking installation just as it is applied. Pipelines are gun-barrel straight, firm end to end. The look of a power plant!

Fibrocel's dimensional uniformity again pays off in fuel savings—pipe is always "dead center," with lengths butted tight to provide maximum insulating effectiveness.

Let us send you the informative new brochure, IN-155A. It gives you full details on Fibrocel's thermal performance. Illustrations show why Fibrocel installs easier . . . takes abuse, too. Keeps its fine appearance and performance excellence for the life of the installation. Write for it today!

Address Johns-Manville, Box 14, New York 16, N.Y. In Canada: Port Credit, Ontario.

JOHNS MANVILLE JM PRODUCTS

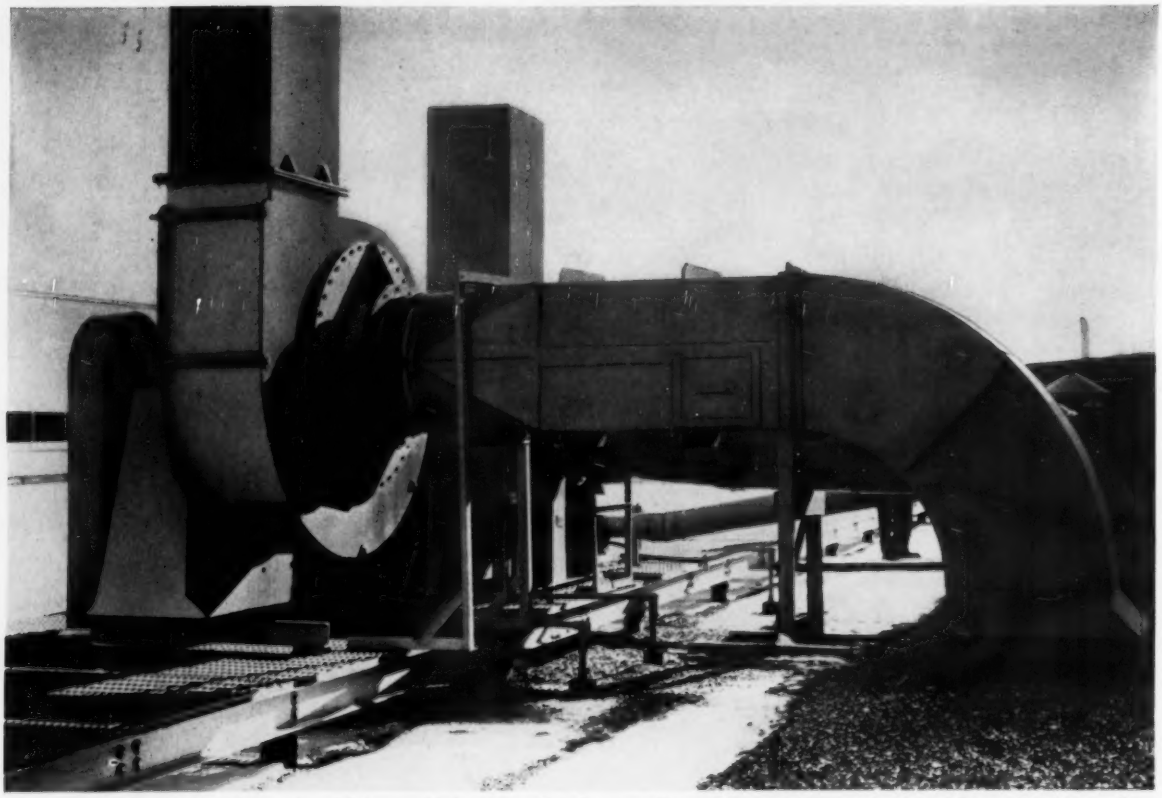
JOHNS-MANVILLE

...Specify Fibrocel for the "POWER PLANT" look in installations like these (35F to 300F)

HOSPITALS
INSTITUTIONS

Another new development using

B.F.Goodrich Chemical *raw materials*



Blowers and fans, ductwork and fittings and bolts, nuts and washers are all manufactured of Geon by Industrial Plastic Fabricators, Inc., Norwood, Mass. B.F.Goodrich Chemical Company supplies the Geon polyvinyl material.

Blower and ductwork of Geon solve corrosive fume problems

The manufacturer of this air handling equipment can promise buyers efficiency as high after years of operation as right now. The equipment is made from sheet made of Geon rigid vinyl. Unlike conventional coated blowers and fans which usually handle just one type of chemical fume, this equipment withstands corrosion and residual build-up of nearly all chemicals. Installations are often lower in cost because of weight savings.

Sheet of Geon rigid vinyl is extremely versatile for fabrications like this—it can be heat-formed to a variety of shapes, precision welded, machined and finished to close tolerance. The flexibility made possible with Geon makes possible new design features impractical with other materials because of prohibitive costs.

Geon rigid vinyl materials are providing new applications and new markets for a broad variety of manufacturing companies. For information about the many forms in which Geon can be obtained, write Dept. AX-5, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich GEON polyvinyl materials • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers

Heating Piping & Air Conditioning

November 1959

You'll Want To Know...

Which Should It Be — Closed or Open Specifications?

For news of new products, see the Equipment Developments department in this issue, and for new catalogs, bulletins, etc., see the Recent Trade Literature columns. Other news material also appears in the Who's What and the We Hear That departments. Meetings and Conventions are listed toward the back of this issue under that title, as are New Books and Reports.

THIS was the subject of the first seasonal meeting of the Chicago Chapter of the Construction Specifications Institute held recently. A three-member panel consisting of the following presented different views on the subject:

a) Harold Algeo — Perkins & Will, architects.
b) Robert L. Franklin — Holabird & Root, architects.
c) James C. Bort — Schmidt, Garden & Erikson, architects and engineers.

Mr. Algeo spoke in favor of the restricted specification. He explained his reasons and the occasions that this was used. One application of the restricted specification is used in his organization where expansion of existing buildings is involved. He pointed out that only one product is specified in this case to minimize maintenance problems and to standardize on the supply of replacement parts for the mechanical equipment. Another case where this is used is where the client specifies the exact product to be installed.

Mr. Franklin said it is more difficult to conceive a completely closed specification than a completely open one because building materials that are not fabricated by the contractor are generally referred to as conforming to the requirements of certain association standards or rules. Thus, the open specification really applies in all these cases where American Society for Testing Materials standards apply as well as for the American Standards Association, Federal Standard Specifications, and others.

Mr. Franklin pointed out that the nearest approach to completely open specifications is in the requirement of the Federal Government agencies. He pointed out that the specification should be written around the function and quality of the item to be used, preferably naming three or more equivalent manufacturer's products from which the contractor may figure his bid.

Mr. Bort felt that there was a place for each type of specification in any building, depending upon the application. He explained a base bid and alternate procedure that has worked

very well in his organization when applied to principal items of equipment and design. The specification is prepared by the engineer with the products written into the specification that were selected in the design of the systems. The bidder must base his bid on these specific products. The engineer provides an opportunity for alternate bids on specific alternate products which he names on the bid form.

The contractor may submit an alternate bid based upon a substitute product, and if this alternate bid is accepted, the substitute product goes into the contract. This approach can be applied to subcontractors in critical trades. A specific subcontractor is specified by name with one or more alternate subcontractors named on the bid form.

This method, Mr. Bort explained, is a positive method of protecting the owner and permits any savings to be realized by him without any sacrifice in quality.

Construction Contracts Decline Due to Steel Shortage

U. S. CONSTRUCTION CONTRACTS declined 11 percent in August compared with the corresponding month of 1958, according the F. W. Dodge Corp.

George Cline Smith, vice president of the firm attributes a large part of the decline to the steel strike. Mr. Smith said that, "nearly every category of non-residential buildings and heavy engineering reported a decline in August, and so did apartment buildings.

Heavy engineering contracts in August amounted to $571,324,000 a decrease of 39 percent from August, 1958. Construction totals for the first eight months of 1959 were: $25,573,909,000, up 7 percent; non-residential building, $7,841,631,000, up 3 percent; residential building, $12,115,843,000, up 28 percent; and heavy engineering, $5,616,435,000, down 16 percent.

Of the 11 percent decline in non-residential building, only hospitals showed a marked improvement, rising 50 percent in total over 1958.

Hotel Snow Melting System Nearing Completion

WORKMAN GAS WELDS ⅜ in. diameter bleed lines to ¾ in. diameter wrought iron pipe placed on 14 in. centers for the snow melting system at Penn-Sheraton Hotel in Pittsburgh. Bleed lines or air vents are installed at all high points of the system to remove air. The snow melting system now completely encircles the hotel, assuring safe winter walking, according to the A. M. Byers Co.

Atomic Submarines Depend on Air Conditioning

THE GROWING IMPORTANCE of air conditioning for atomic submarines is especially evident when the increase in cooling capacity of 160 tons in the Nautilus is compared with the 300 tons of capacity being installed in the George Washington — the new Polaris missile submarine. This capacity will have to be increased even further, up to 390 tons and higher, to accomplish what is needed for later ships, according to E. H. Honeggar of the Dept. of the Navy, Bureau of Ships, speaking at the October meeting of the Illinois Chapter of the American Society of Heating, Refrigerating and Air-Conditioning Engineers.

Design requirements including the purification of the atmosphere to keep the concentration of CO_2, CO, refrigerants, and other gases below tolerable limits are only some of the problems that have been solved to provide the right environment for the crew in order to keep submerged for days or weeks at a time. An effective temperature of 78 F with a dry bulb temperature of 85 F is the design condition for the ship except the engine room where 100 F is tolerated. The equipment must be capable of providing these conditions with a maximum sea water condensing temperature of 85 F. Of course with a lower water temperature, these inside conditions can be maintained at lower levels. However, it must be realized that the air conditioning equipment must absorb all moisture liberated into the air such as perspiration, vapor from cooking and bathing, and any steam leaks that might occur.

Present atomic submarines utilize the reactor to produce steam which

is used to operate the auxiliary equipment including electric generators. A large portion of the air conditioning load is attributed to the residual heat from the reactor, generators, motors, and other heat producing equipment. Because of this, cooling is required all the time and humidity control is achieved by means of reheat coils.

The George Washington is equipped with five 60 ton reciprocating compressors to provide the total cooling capacity of 300 tons. Chilled water is circulated throughout the ship at a flow rate of 3 gpm per ton in a loop to 18 cooling coils at various points. A high pressure duct distribution system, operating at pressures of 10 to 15 in. water gage, is used in the living quarters. Some of the air is passed through the cooling coils and the remainder is bypassed around the coil, after which the air can be mixed automatically before being admitted into the occupied space.

Electronic equipment and other heat producing equipment are cooled directly by spot cooling and each area is independently controlled. Sea water is also used for cooling certain equipment indirectly.

Because of the severe space limitations, there is little room to repair any components of the system if failure occurs. Therefore, reliability is most important. Since air conditioning must be installed as the ship itself is being built, all components that make up the system—compressors, condensers, pumps, fans, piping, and duct-work are pretested prior to final assembly. These items cannot be added later or removed through the 25 in. hatch if they could be dismantled in the ship through the complex and compact installation. This equipment is not conventional in many respects because it must be resistant to shock. For instance, nodular iron or steel is used in place of cast iron for heavy pieces. Also, provisions must be made for proper operation of the equipment when the ship is in a roll of 60 deg.

Keeping the noise level low is an absolute necessity, and to minimize vibration from the compressors, five cycle mounts are used. To achieve quieter equipment in view of the ever increasing need for more air conditioning capacity, 13 submarines are now under contract which will be provided with absorption air conditioning. Each of the latest ships will include one 170 ton lithium bromide absorption refrigeration machine together with two 110 ton reciprocating compressors. One of the problems that had to be solved was the performance of the absorption refrigeration machine under roll, list, and trim of the ship.

In a question period following the presentation by Mr. Honeggar, it was brought out that the Navy is now using a 90-10 Cu-Ni tube with a high iron content in the condensers on surface ships because of the high corrosiveness of the salt water.

Air Conditioned Sidewalk Aids Department Store Sales

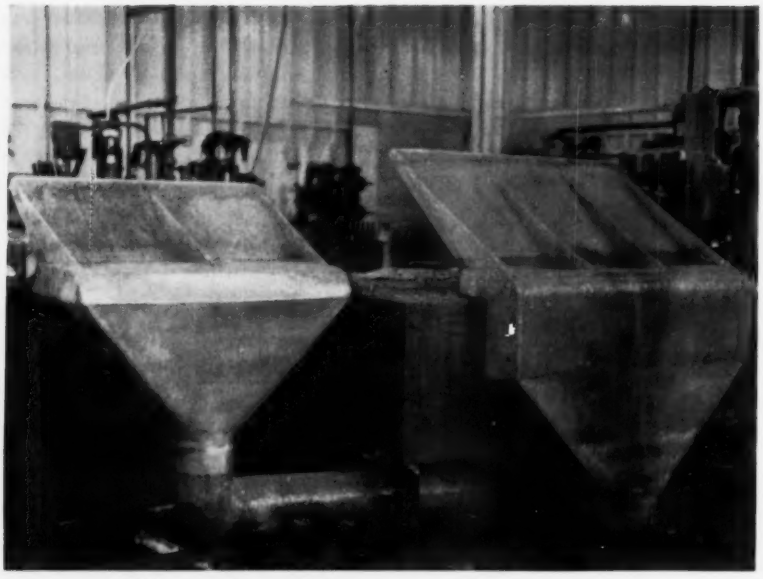
ONE OF THE WORLD'S FIRST out-of-doors air conditioning installations was recently witnessed by thousands in New Orleans. Lined along Canal Street were large, blue and white portable air conditioning units with plastic ducts stretching high into the air and attached to the Maison Blanche department store. The air conditioning promotion was a cooperative effort of Maison Blanche and Ready Cool, Inc., air conditioning contractors, which provided the units.

Joseph W. Joachim, Jr., president of Ready Cool, Inc., stated that, to the best of his knowledge, this was the first time an air conditioning project of this type—for an entirely open sidewalk—had been undertaken. Models demonstrated the effectiveness of the air conditioned environment by parading in winter and fall fashions.

The portable units were parked along Canal Street from noon until 8 pm with each unit delivering 18,000 cfm of dehumidified, filtered air, 25 to 30 F below the surrounding

temperature. The cooled air was forced down to the sidewalk through the network of plastic ducts.

Photo courtesy of Dennis Cipnic



Plastic Ducts Remove Fumes and Heat

REMOVAL OF CORROSIVE FUMES and heat from molten tin had been a problem for the Canada Wire and Cable Co., Ltd. until installation of reinforced plastic ducts over their tinning machines. These ducts, which have been in place nearly a year, show no evidence of breakdown according to the Durez Plastics Div., Hooker Chemical Corp.

Four pairs of ducts are installed on the tinning machines. The duct on the right side of the photograph is over a tinning bath and receives hot fumes from the operation, since the operation for the process radiates considerable heat and some toxic fumes. Also, there is an open flame within 2 in. of the polyester duct, which is fire resistant. The duct on the left side draws heated corrosive acid fumes from a muriatic bath. The ducts are fairly large, one being 60 in. wide, and the smaller approximately 45 in. across its front.

The corrosive fumes pass through the primary hoods and into ductwork also fabricated of polyester resins and out of a polyester-reinforced fibered glass stack.

Compressor Body Shipments Up

COMPRESSOR BODY shipments during the first five months of 1959 for all uses except household refrigerators totaled 2,582,694 units, compared with shipments of 1,806,180 units in the same period of 1958, according to the Air-Conditioning and Refrigeration Institute.

ARI figures show a gain in shipments over last year that amounts to about 43 percent.

AWS Releases New Soldering Manual

THE FIRST comprehensive soldering manual ever published has been released recently by the American Welding Society.

Chemical composition of hundreds of solders are given, together with flux formulations for the various metals. Copies may be had from the American Welding Society, Dept. T, 33 W. 39th St., New York 17, N.Y., at a list price of $5.00.

Merchandise Mart Adds To Air Conditioning

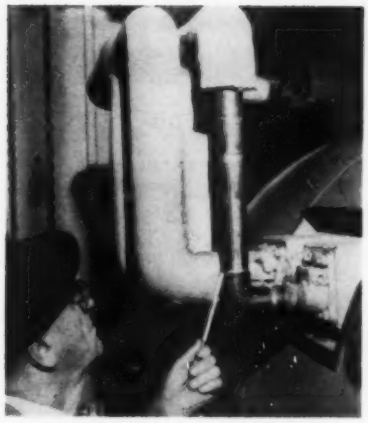
THE WORLD'S LARGEST commercial office building, Chicago's Merchandise Mart, has regained its position as the most air conditioned commercial structure, according to Carrier Corp. Installation of a water chilling machine with a cooling capacity of 1100 tons has boosted the Mart's total capacity to 10,040 tons.

A total of 11 central plant refrigeration machines furnish 9800 tons of cooling for the Mart's over 4 million sq ft of floor space.

Use Stainless Volute In Nuclear Plant Pump

A LARGE stainless steel canned pump volute is being made for the Yankee Atomic Electric Co.'s 134,000 kw nuclear power plant at Rowe, Mass. The finished canned motor pump, which will be hermetically sealed, will be over 11 ft high and will weigh 39,000 lb, according to Westinghouse Electric Corp.

Along with three other units, the canned motor pump, rated at 1600 hp, will circulate radioactive water at 496 F through the nuclear reactor system pressure of about 2000 psi. There will be an 80 psi pressure rise across the pump. Both the rotor and stator of this type of pump are encased in metal. Water being circulated flows through the space between the rotor and stator, thus acting as a coolant and lubricant.



Solve Pipe Joining Problem In Hard Water Area

THE PROBLEM OF LIME and other chemicals in the local water of Jefferson Elementary School at Mount Vernon, Washington caused solders at pipe joints to etch, or oxidize, according to All-State Welding Alloys Co.

In determining the how to join copper pipe in sizes from ½ to 4 in. diameter and to join copper piping to the iron boiler, it was recommended that a silver bearing solder be used which flowed freely at 430 F. This solder proved satisfactory in joining pipe in the entire range of sizes and worked equally well on iron to copper joints.

The Jefferson School job was completed in 1955. Inspection indicates that fittings are water tight.

Boiler Failures Caused by Operator Carelessness

HUMAN FAILURE has been determined to be the reason for most boiler failures, according to the Boiler Engineering & Supply Co. In figures released by the Hartford Steam Boiler Inspection and Insurance Co., 85.2 percent of 1715 steel firetube boiler failures were traced to neglect, carelessness, indifference, or ignorance on the part of the boiler operator. Over half of the failures were reported as failure to test and maintain control devices. Proper operator instruction is said to be the key to lessening failures.

French Engineer To Visit U.S. Lab Facilities

DURING NOVEMBER, U. S. and Canadian environmental laboratories will receive a distinguished visitor from France. Dr. M. Croiset, head of the Hygrothermic Division of Materials in Comfort and Study of Materials and Methods of Construction, Scientific and Technical Building Center, Paris, will visit several laboratories in order to obtain information for an experimental laboratory to be constructed in France.

The French laboratory will be used to study variations in the characteristics of insulating and construction materials as they occur due to temperature and humidity changes.

Dr. Croiset has been assisted in planning the intinerary of his U. S. tour by Professor M. K. Fahnestock, Chairman of the Physical Environment Unit, Mechanical Engineering Laboratory, University of Illinois.

Air Conditioned Disneyland Subs Keep Tourists Comfortable

COOLING AND HEATING comfort in the world's most unusual submarine fleet —at world famous Disneyland— proved to be a very important part in their design. The air conditioning had to be trouble free under continuous use during peak months and provide for even, comfortable temperature in the craft, both summer and winter.

The 38 passenger submarines incorporate a system of diffusers to prevent moisture accumulation inside the individual passenger view ports (windows) located below the water line of the sub. Each of the 38 view ports has a small diffuser placed in the base of the frame. By "bouncing" fresh, conditioned air off the insulated glass, moisture is completely evaporated and the conditioned air blowing by the passenger's face helps overcome the feeling of being closed in, according to the Recold Corp.

The cooling and heating system consists of one split circuit direct expansion coil used in conjunction with two shell and tube condensers, two 2 ton compressors, and one hot water coil. Cooling and heating coils are located in the conning tower of the submarine and condensers and compressors are located in the machinery section at the rear of the sub.

Air in the vessel is recirculated through an activated charcoal filter for eliminating odors and a replaceable media filter to remove dust. Outdoor air is vented into the coils through louvers at the front and top of the conning tower. A constant 70 F temperature is maintained.

Design New Office Duct Systems As Part of Structural Columns

A NEW office building duct system combining structural columns with the air distribution system has been incorporated into two new buildings — one in Buffalo and the other in Cleveland, according to Tishman Realty & Construction Co., Inc.

The primary reason for using this method was to conserve rentable space. Since the structural columns are made of reinforced concrete rather than structural steel, considerable usable space would have been lost by installing separate ducts.

Since the load on a structural column decreases as the column rises in a building, the column can grow thinner as it goes up. Therefore, the air conditioning equipment was located on the roofs of the two buildings, to permit the largest duct sizes to be included in the smallest columns. Conditioned air is delivered down the air ducts within the columns, and individual floors are served by branch ducts.

Because the air ducts for the system are larger near the tops of the buildings, they are "telescoped" within the structural columns. In the Buffalo building, this was done by using a U-shaped reinforced concrete structural column, attaching Z-bars, then welding a plate onto the Z-bars at the open end of the column. The open area within the columns carries the air from the equipment on the roof.

The Cleveland building has round ducts placed in square openings built into the concrete columns as the columns were formed. These ducts vary from 8 to 14 in. in diameter.

The Cleveland building has an air conditioning cooling capacity of 1100 tons and most of the ducts are 12 in. in diameter. In the Buffalo building it is 530 tons and the ducts are 10 in. in diameter.

Study Radiant Heating Snow Melting in New Plant

A NEW PIPE BENDING and fabrication plant is now being built for Atlantic Pipebending & Fabricating Co. at Moonachie, N. J. which will also be used to study snow melting and radiant heating installation procedures. The 4000 sq ft plant will have several types of floor panels installed in the concrete slab. Special studies are to be conducted in the area of two large truck doors, according to S. H. Nitzberg, president. Floor panel heating will be combined in this area with high temperature radiant heating elements mounted overhead at various heights.

Separate test slabs, 20 x 20 ft, will be installed in the driveway for studying the effectiveness of snow melting. Some of these slabs will be concrete while other surface materials will be used in alternate slabs. Also, different coil designs will be installed and various types of heating fluids will be used including oil, water and different concentrations of water and ethylene glycol.

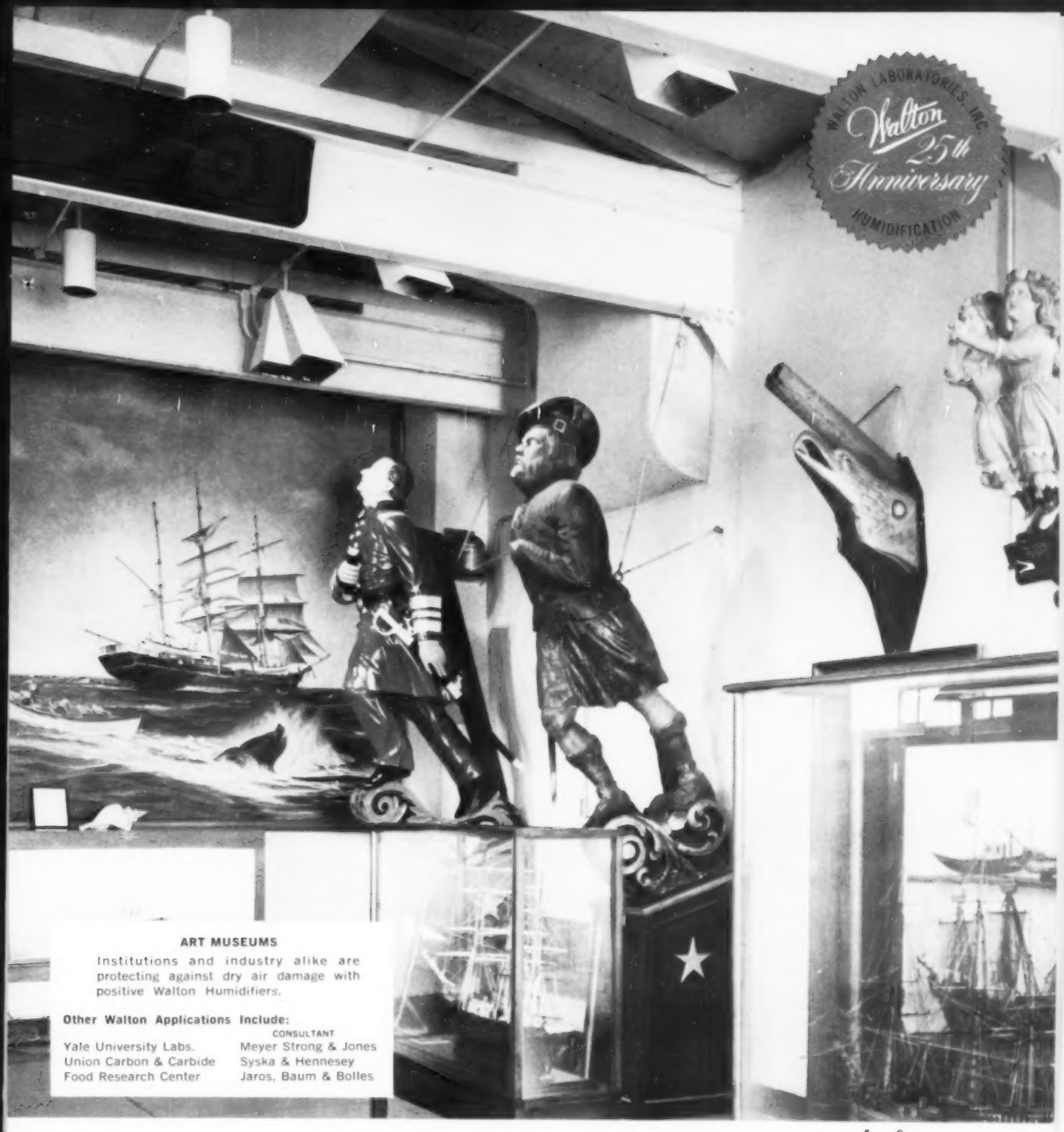
An 800 sq ft office area is being built on a suspended slab over the plant which will have different types of coils installed in the floor. Operating characteristics will be observed and correlated with different installation procedures used during construction.

Carnegie Tech Scholarship Competitions Now Open

CARNEGIE INSTITUTE of Technology has announced the opening of competition for George Westinghouse Scholarships. Ten four year scholarships, valued at $1250 each will be awarded to secondary school seniors.

Eligibility for the scholarships is limited to senior secondary school students (public, private, or parochial) in the top tenth of their graduating class.

Requests for application forms must be received by December 1, 1959, by the Chairman of Admissions, Carnegie Institute of Technology, Pittsburgh 13, Pa. Applicants will be required to take the College Board tests on March 14, 1960.



ART MUSEUMS

Institutions and industry alike are protecting against dry air damage with positive Walton Humidifiers.

Other Walton Applications Include:

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Yale University Labs.	Meyer Strong & Jones
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They Wanted Real Humidification . . . they used Walton

KEEP ABREAST OF HUMIDIFICATION DEVELOPMENTS. Registered architects need only send their name and address to receive Walton's all-inclusive Architects and Engineers File plus the monthly Markets and Methods reports.

A COMPLETE LINE OF HUMIDIFIERS

. . . For Any Heating, Ventilating or Cooling System
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All featuring Walton's patented centrifugal atomizer for positive, controlled humidification.

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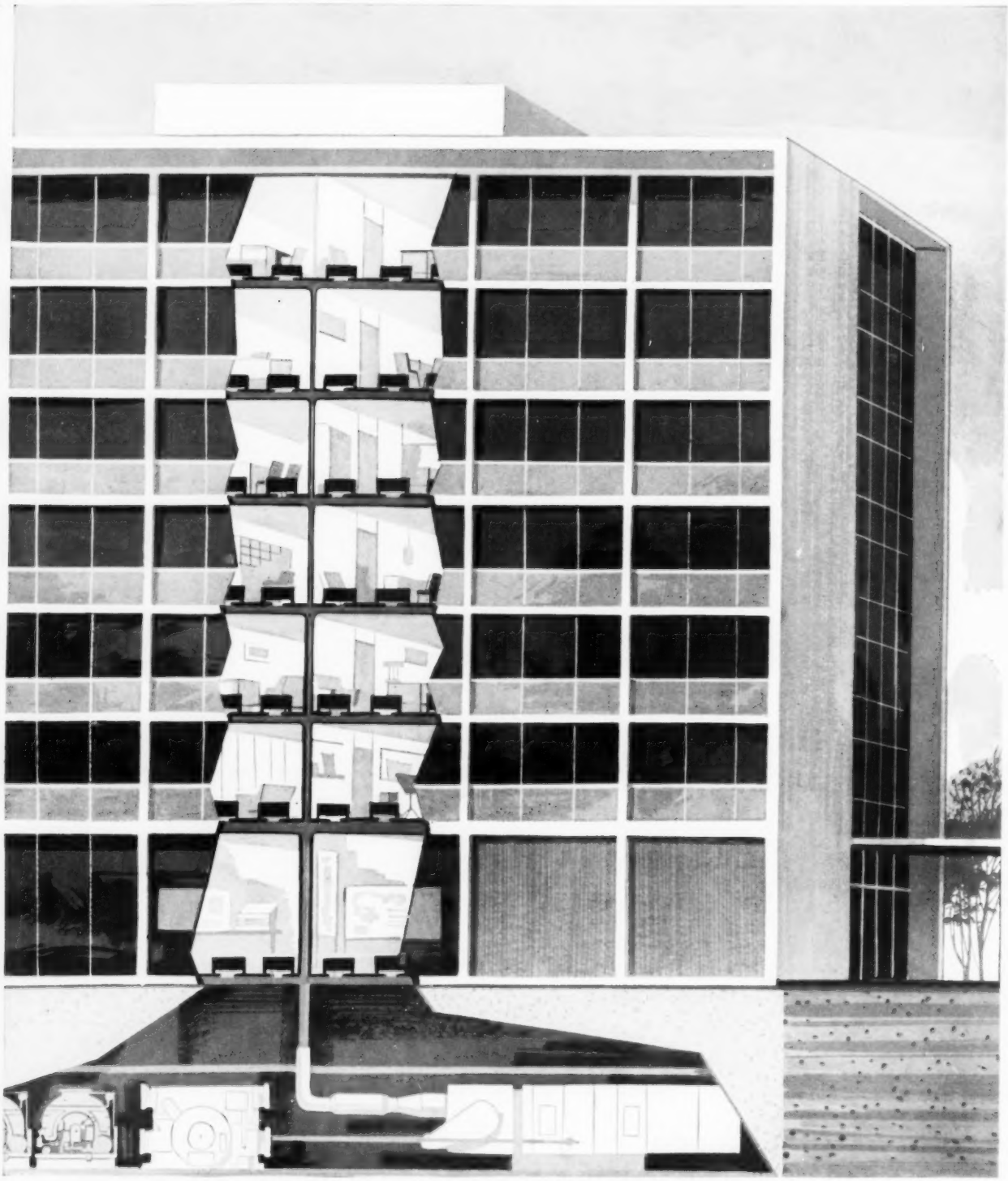

One call for all

CENTRIFUGAL REFRIGERATING MACHINES • CENTRAL-STATION AIR CONDITIONERS
PACKAGED WATER CHILLERS • PACKAGED AIR CONDITIONERS • FANCOIL UNITS
MULTI-ZONE AIR CONDITIONERS • SPRAYED COIL DEHUMIDIFIERS • HEATING AND
COOLING COILS • CENTRIFUGAL FANS • PROPELLER FANS • POWER ROOF VENTILATORS
UTILITY SETS • UNIT HEATERS • BOILERS

Why select air-conditioning equipment by the piece instead of the package?

IN BUYING a car, you wouldn't dream of going to one company for the engine, another for the body, another for the wheels and so on. You get the complete package from one source.

Today it's possible to select air-conditioning, heating, and ventilating equipment by the package instead of the piece — and get a more integrated system. American-Standard* Industrial Division offers *all* major components, from the combined American Blower, Ross Heat Exchanger, and Kewanee Boiler product lines. You benefit by having one-source responsibility for quality and performance in equipment designed, engineered, and manufactured to work together.

There are offices in all principal cities staffed with product specialists to assist with equipment selection and on-the-job problems. Call the one nearest you. AMERICAN-STANDARD INDUSTRIAL DIVISION, DETROIT 32, MICH. IN CANADA: AMERICAN-STANDARD PRODUCTS (CANADA) LIMITED, TORONTO, ONTARIO.

*American-Standard and Standard ® are trademarks of American Radiator & Standard Sanitary Corporation.

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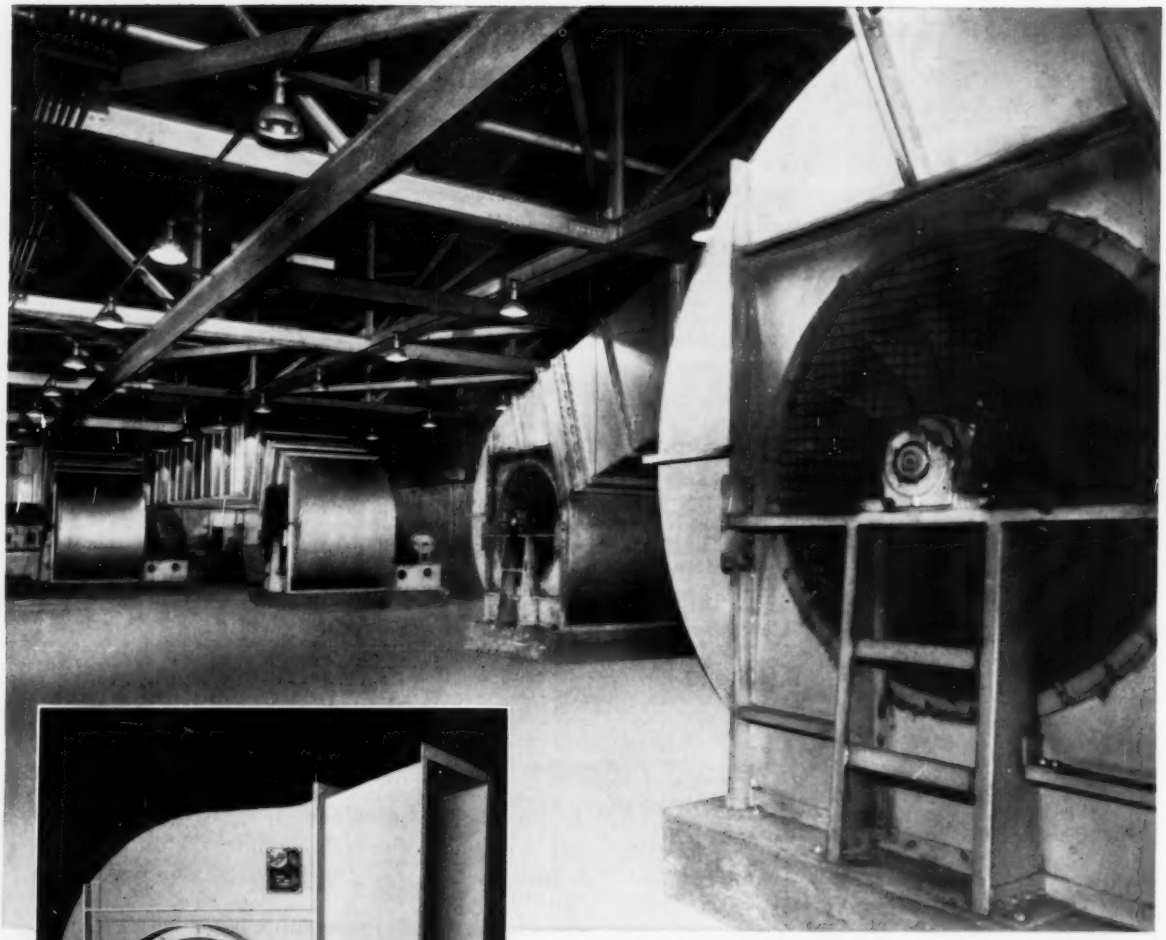
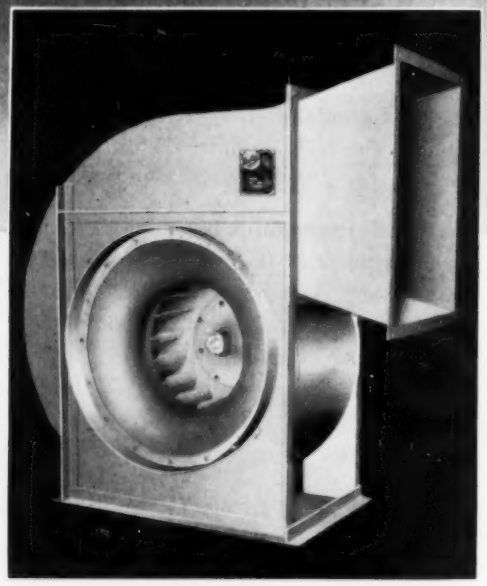


Four "Buffalo" Type "BLD" Double Width Fans Ventilating Rolling Mill Motors.



RUGGED TYPE "CR" radial blade fan that is widely-used in steel mills and the cement industry for extremely severe service.

VENTILATION NEEDS

"Buffalo" Fills Them All . . . even the "Tough" Ones !

"Buffalo" recognizes that different ventilating problems require different fans and equipment. That's why "Buffalo" has developed a complete line of fans and equipment to cover almost every possible air moving need. 82 years of air moving experience are at your service when you call on "Buffalo". Our field engineers are qualified men with a broad background of air moving know-how.

"Buffalo" products bring you the "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.

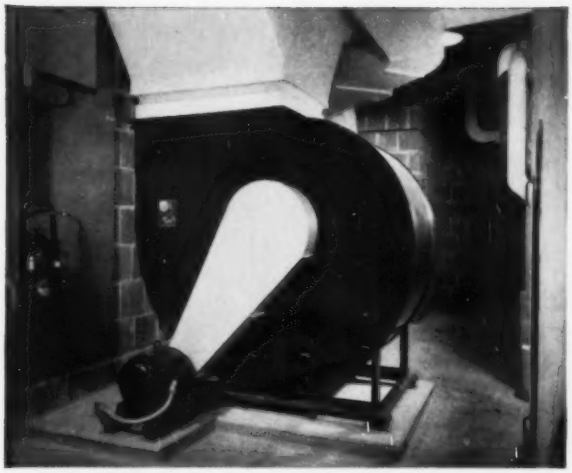
For complete information on *your* air moving requirements, call your nearby "Buffalo" engineering representative — or write us direct.

"Buffalo"

BUFFALO FORGE COMPANY BUFFALO, N. Y.

Buffalo Pumps Division • Buffalo, N.Y. Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

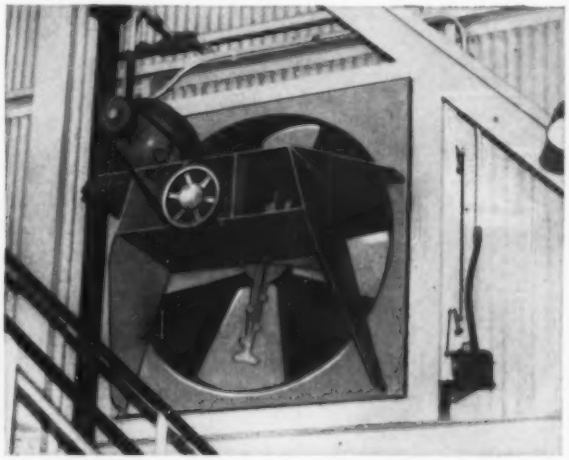
VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING



CENTRAL SYSTEM ventilation, which very often incorporates air conditioning and heating, requires the high efficiencies and capacities of large centrifugal fans. Capacities range to 500,000 cfm.

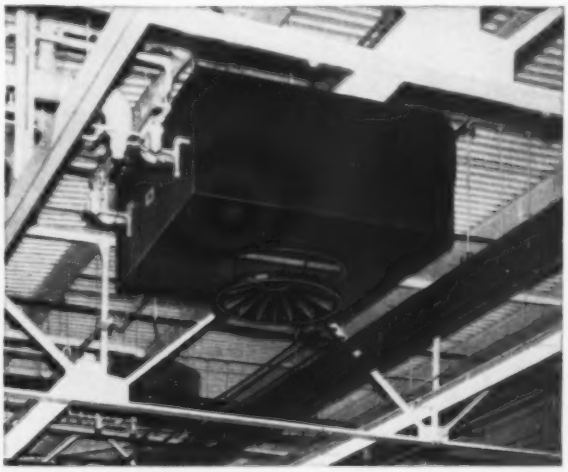
THROUGH THE ROOF is the best way to ventilate large areas where duct work is undesirable. Allows flexibility of plant layout. New models in capacities up to 250,000 cfm.

CONFINED AREA exhaust such as spray booths, hood installations, function best with efficient, powerful axial flow fans. Units easily installed in ducts.

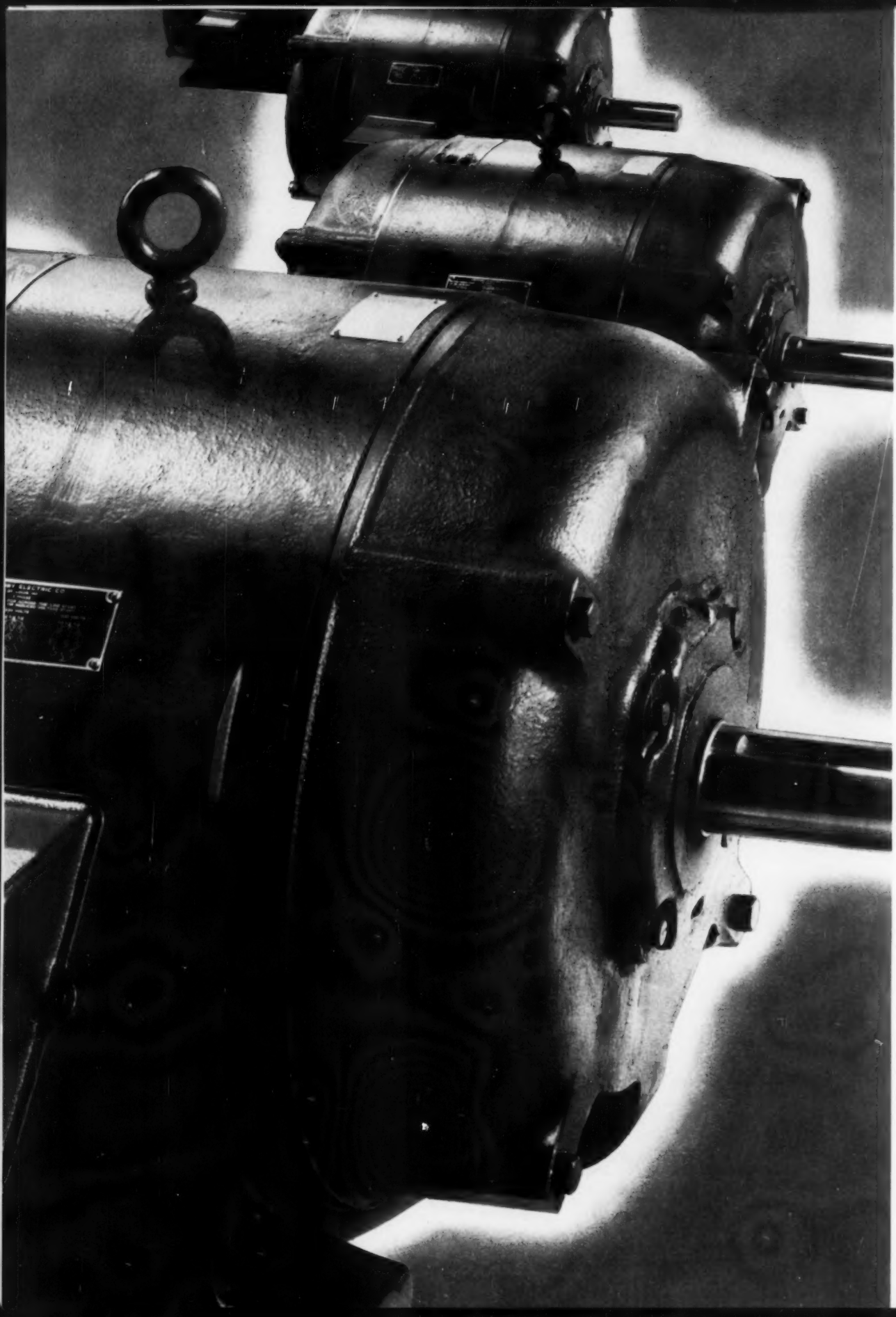


LOWEST COST ventilation for open areas is made possible by large propeller fans. New designs offer higher efficiencies, larger capacities (250,000 cfm).

CORROSIVE FUMES can be exhausted with cast iron fans as shown. Also available are fiber glass fans, rubber and other specially coated units.



PUTTING BACK AIR exhausted is job for low cost, high capacity make-up air units. Fans, heating coils, filters, diffusers included in "package" units.



1959–15,000,000 horsepower
1965–26,000,000 horsepower

Conservative estimates place the total horsepower of all motors driving fans and blowers in the United States at about 15,000,000 horsepower. And in 1965 it is estimated that the total will be about 26,000,000 . . . an annual growth of 5% for the air moving industry. To make sure all this equipment gives top performance requires careful matching of motor to equipment . . . and a wide variety of different types of motors. Century Electric application engineers can help you select the right motor for your fans, blowers and allied equipment:

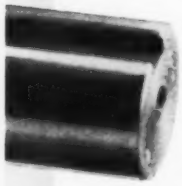
For fans—Two basic types of motors, CS and CP, meet most requirements for fans operating from single phase power. Both these Century Electric capacitor start motors provide high starting torque. Fans operating from polyphase power perform best with SC and SCM motors.

For blowers—If the starting load is light or if there will be short time increases in load, then the Century Electric Type SC polyphase motor is ideal. It will give you enough starting torque, and with low starting current. It comes in 1/6 to 400 hp sizes. If you need two, three or four different fixed speeds while the blower is running, the Century SCM polyphase motor will do the job.

For compressors—Where high starting torque is required to overcome great inertia or backpressure, the Century Electric Type SCH polyphase motor is right. This motor comes in sizes ranging from three to 400 hp and in dripproof, totally-enclosed and explosion-proof enclosures. It also provides the right kind of power to drive reciprocating pumps with high starting torque requirements.

For pumps—Centrifugal pumps, whose torque demands increase with speed, perform best with Century Electric SC polyphase motors. Reciprocating pumps with high starting torque requirements need the SCH. For all types of pumps, as well as for compressors and blowers, Century Electric makes single phase motors.

For special applications—Century Electric makes a variety of motors for specific operating conditions. The shaft-mounted fan motor is designed for unit heaters and evaporators. It comes in 1/3 to 3 hp sizes. Hermetic motors can be built right into a refrigeration compressor unit . . . they are manufactured under rigid quality controls to make sure they are free of contaminants that could damage capillary tubes and valves.



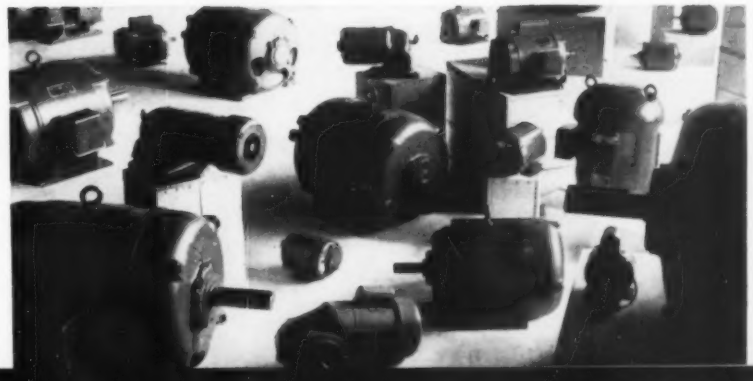
FOR MORE INFORMATION—Please contact your nearest Century Electric Sales Office or Authorized Distributor. You will find Century Electric's new Motor Application Guide helpful . . . please write for bulletin 270A. For *more* than a motor . . .

CENTURY ELECTRIC COMPANY

St. Louis 3, Missouri *Offices and Stock Points in Principal Cities*

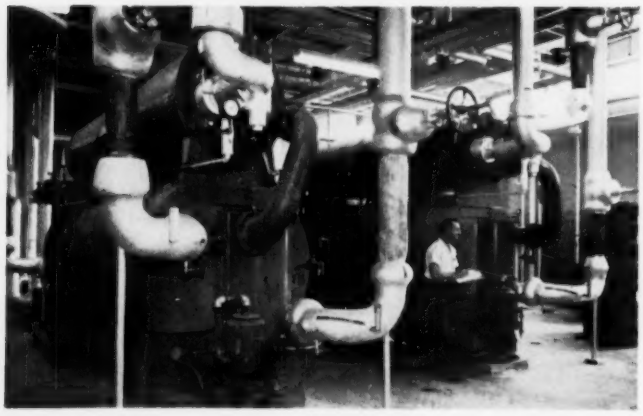
Century 59-8

FROM OVER 10,000 TYPES of motors—AC and DC . . . single phase and polyphase . . . from 1/20 to 400 hp—you can find the right one from Century Electric for your application . . . the one that provides the best performance commensurate with cost.



NO SUMMERTIME SLUMP With gas as the boiler fuel and York machines, the switch to summer cooling was no problem. Operating costs are low, too, thanks to Gas.

LATEST IN COOLING Gas operated York machines feature the use of tap water as refrigerant and lithium bromide as absorbent, one of the most efficient, practical refrigeration cycles developed so far. Machines start and stop automatically.



THE UTMOST IN FLEXIBILITY The units are cross-connected so that each operates independently if necessary.

MAINTENANCE COSTS TO DATE—ZERO! The Allen Company uses two York machines—a 230-ton unit serving 45,000 sq. ft. of office and cafeteria space, a 170-ton unit for process water cooling. Three small pumps and motors are the only moving parts in the entire system.

"with **YORK GAS** *air conditioning our boilers keep us cool all summer"*

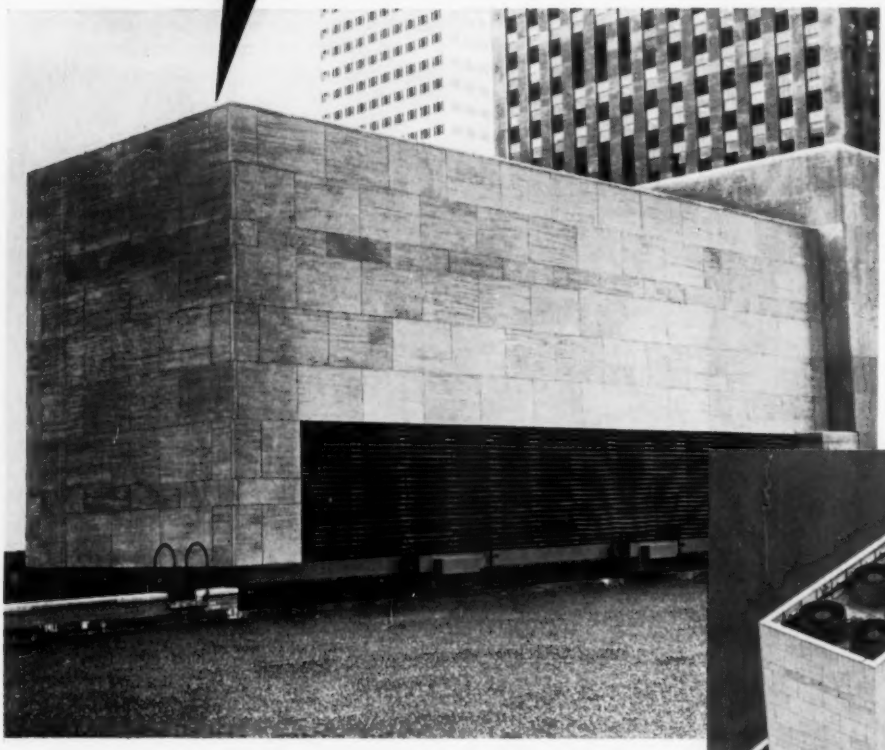
"With our boilers sized for a winter load, we were naturally oversized for the summer months. But York's gas-operated Lithium Bromide absorption water chillers permit us to make efficient use of part of this steam capacity to cool," says Mr. M. J. Mather, President of the Allen Manufacturing Company, makers of hex-socket screws.

The York Lithium Bromide system eliminates the need for huge compressors found in other types of cooling equipment . . . which brings down the original cost considerably. And with gas the boiler fuel, you make year-round use of an otherwise wasted source of power *at rock bottom costs.* In addition, York machines are noiseless, lightweight, compact—easy to install and readily adaptable to almost any plant layout.

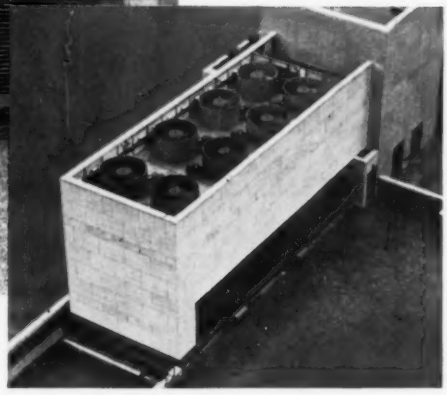
Find out how your present heating system can pay off for you all year 'round with gas-operated York automatic water chilling units. Call your local gas company or write to the York Corporation, Subsidiary of Borg-Warner Corporation, York, Pennsylvania. *American Gas Association.*

Here's how Phillips solves

another problem solved by Phillips CUSTOM ENGINEERED COOLING TOWERS



RADIO CITY MUSIC HALL
ROCKEFELLER CENTER
NEW YORK, N. Y.



The problem:

Combining beauty and efficiency in a limited space at low cost.

The solution:

PHILLIPS CUSTOM ENGINEERED COOLING TOWER with limestone casing to blend perfectly with surroundings. Space utilized so that additional tower may be erected as need arises. This tower gives maximum cooling surface per foot of space, and minimum maintenance cost.

cooling tower problems CUSTOM ENGINEERING

Whatever the problem — noise . . . freezing . . . space . . . maintenance . . . atmospheric conditions — you'll find PHILLIPS CUSTOM ENGINEERED COOLING TOWERS solve the problem better . . . at less cost. Why? Because here are the only cooling towers that are custom engineered to suit the conditions of each application. No wonder each year, more and more specifications call for PHILLIPS CUSTOM ENGINEERED COOLING TOWERS.

EVERY STEP CUSTOM ENGINEERED

CASINGS
Selection of material to fit Architectural treatment and surrounding conditions.

BASINS
Redwood, stainless steel, galvanized steel, carbon steel up to and including ¼" thickness with any desired coating, reinforced concrete basins supported on steel beams.

FILL
Redwood or pressure treated Douglas Fir. Slip-fit, self-supporting for easy removal for interior maintenance.

FANS
Multi-blade, adjustable propeller type fan in cast aluminum, stainless steel or Monel. Either direct driven fan in small sizes or indirect right angle worm gear drives.

DISTRIBUTION SYSTEM
Spray nozzle type or open Weir gravatational type system.

FRAMEWORK
Hot dipped galvanized structural steel .250" minimum thickness. Redwood or pressure treated Douglas Fir.

Write for literature

SPECIAL FEATURES ON ALL TOWERS

Corrosion Resistant Hardware. Aluminum or Stainless Steel Fans. Nailless Redwood Filling Removable at Tower Base. Nailless Three-Pass Redwood Eliminators. Removable Louvers.

Phillips Cooling Tower Co., Inc.
220 DUPONT ST., BROOKLYN 22, N. Y.

1. Opens easily...
2. Springs closed ...automatically
3. Fits snugly...
4. Insulates effectively ...in less thickness!

Works 4 ways to keep costs low!

Micro-Lok...new Johns-Manville fiber glass pipe insulation saves hours on the job . . . saves fuel and power costs

No pipe insulation does more than Micro-Lok to save installation time and keep insulation costs low!

Micro-Lok opens easily, springs closed automatically because it has full-length "spring-hinge" action in each section. The hinge actually runs the full length of each section. This, plus its one-piece construction, saves on installation costs in many ways. It helps free workers' hands more quickly for sealing tabs and other operations, contributing to over-all efficiency.

Micro-Lok is the first pipe insulation made of fiber glass which was developed for easy cutting and fitting of the inside diameter around joints and fittings, pipe hangers and other irregularities.

Micro-Lok is available in standard wall thicknesses . . . especially ½" and ¾" . . . for all pipe and copper tubing sizes. The insulation is offered in a choice of factory-applied jackets including canvas, vapor-barrier and flame-resistant . . . to cover a wide range of operating conditions.

For further information on sizes, thicknesses and applications, contact your nearby Johns-Manville representative. Or write to Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ont.

JOHNS-MANVILLE
Fiber Glass

JOHNS MANVILLE JM PRODUCTS

How Micro-Lok speeds application—improves temperature control—saves fuel dollars

"Spring-Hinge" Action. Easy, full-length opening . . . automatic closing . . . and one-piece construction increase worker efficiency.

Light Weight. Weighs only a fraction as much as other materials . . . yet does a more effective insulating job.

Resists Abuse. Resilient Micro-Lok won't break, crush or crumble during shipment or application. The material is pleasant to handle, too.

Snug Fit. Accurate molding of inside diameters and knitting of fibers at joints provide a tight seal.

Superior Thermal Performance. Its finer, longer fibers create countless heat-trapping air spaces . . . surpassing the efficiency of many commonly used materials and permitting more effective temperature control. For still greater efficiency—a unique manufacturing process gives Micro-Lok uniform insulating performance throughout the section. Temperature limit 350F . . . to sub-zero.

Moisture Resistant. Inorganic glass fibers are noncellular . . . do not absorb moisture . . . won't rot, shrink or swell. They're noncombustible, too.

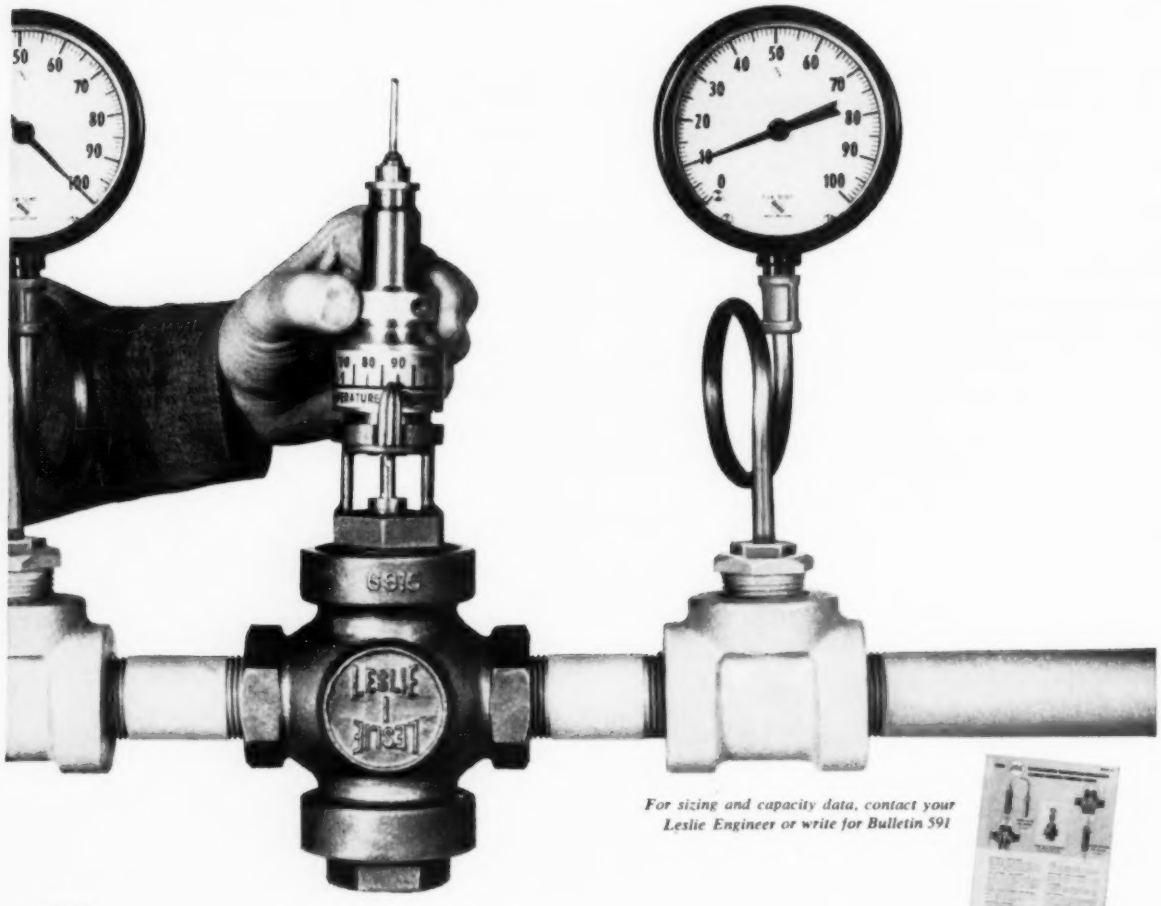
accuracy, reliability
ENGINEERED INTO LESLIE'S COMPLETE

NEW SINGLE-SEATED, BALANCED DISC, TEMPERATURE REGULATOR HANDLES INLET PRESSURES TO 100 psi.

New Leslie regulator can handle inlet pressure and pressure drops to 100 psi. High power, positive movement of an actuating bellows with solid liquid fill, and the virtually friction-less stuffing box provides stem movement exactly proportional to the temperature change at the bulb.

Designed for steam or water service, it features a single seated, self-aligning, tight closing inner valve. (Units can be changed in the field from direct to reverse acting, or from reverse to direct acting, simply by inverting body and main valve.)

Applications include instantaneous heaters or coolers—shell and tube or shell and coil heat exchangers; storage or tank heaters; and, process heaters or coolers of all types. Available in cast iron or cast bronze bodies for temperatures to 450°F. Sizes ¾ and 1", screwed connections.

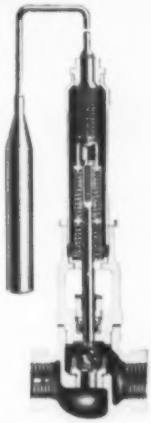


For sizing and capacity data, contact your Leslie Engineer or write for Bulletin 591

LC-10

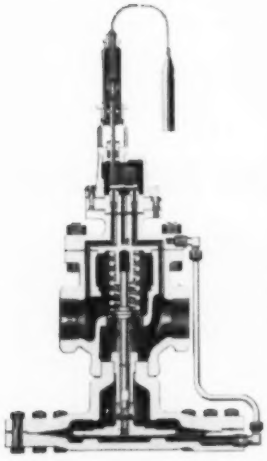
LINE OF TEMPERATURE REGULATORS.

OTHER VERSATILE LESLIE REGULATORS PROVIDE PRECISE TEMPERATURE AND PRESSURE CONTROL



Bellows Operated Temperature Regulator For Small Flows

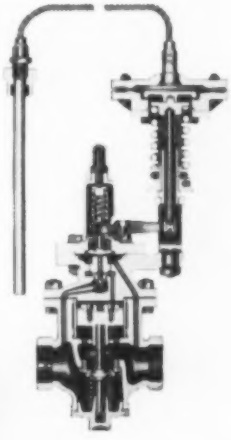
Direct Operated Design is used for small flow heating and cooling service, size ⅜, ½ and ¾". Liquid filled thermostatic element supplies ample power to stroke the single seated main valve. Valve travel is directly proportional to temperature change at bulb. This design is suitable for instantaneous and storage type heaters. It is also available in double seated construction for cooling service.



Class TKM Pilot Actuated, Metal Diaphragm Operated Temperature Regulator

Pilot Operated, Single Element Control also uses the liquid filled element to operate pilot device which applies operating pressure from the regulator inlet to a diaphragm for stroking main valve in heating or cooling service. Large diaphragm area and operating pressure supply ample power for controlling long stroke, single seated main valve with full flow capacity in sizes ½-4". Regulator has a 3 to 5° throttling range and is suitable for all storage type heat exchangers and for any system requiring on-off control.

Class LTCO Pilot Actuated, Piston Operated Temperature Regulator



Pilot Operated, Duo-Matic (two-element control) design offers both temperature and pressure regulating functions in a pilot actuated, piston or diaphragm operated regulator. The valves can handle a range of inlet steam pressures in heating services from 25 to 600 psi and controlled pressure ranges of either 2 to 15 psi or 10 to 250 psi. These characteristics are ideal for all storage type heaters and most instantaneous heater problems. Available in sizes ¼-6" with iron, bronze and cast steel construction.

For complete sizing and capacity data write for Bulletin 5307-A

TRADE LESLIE MARK

REGULATORS and CONTROLLERS

Leslie Co., 437-E Grant Ave., Lyndhurst, New Jersey

Over 275 Factory-Trained Engineers At Your Service—Nationwide!

THIS COUPON WILL LEAD TO PROFITS!

Forge & Fittings Division, H. K. Porter Company, Inc., P. O. Box 95, Roselle, New Jersey
Please send me full literature on your new *Fishmouth*

NAME ..... TITLE .....

COMPANY .....

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CITY ..... ZONE ..... STATE .....

You've Got The Job! Here's How to Make It Profitable!

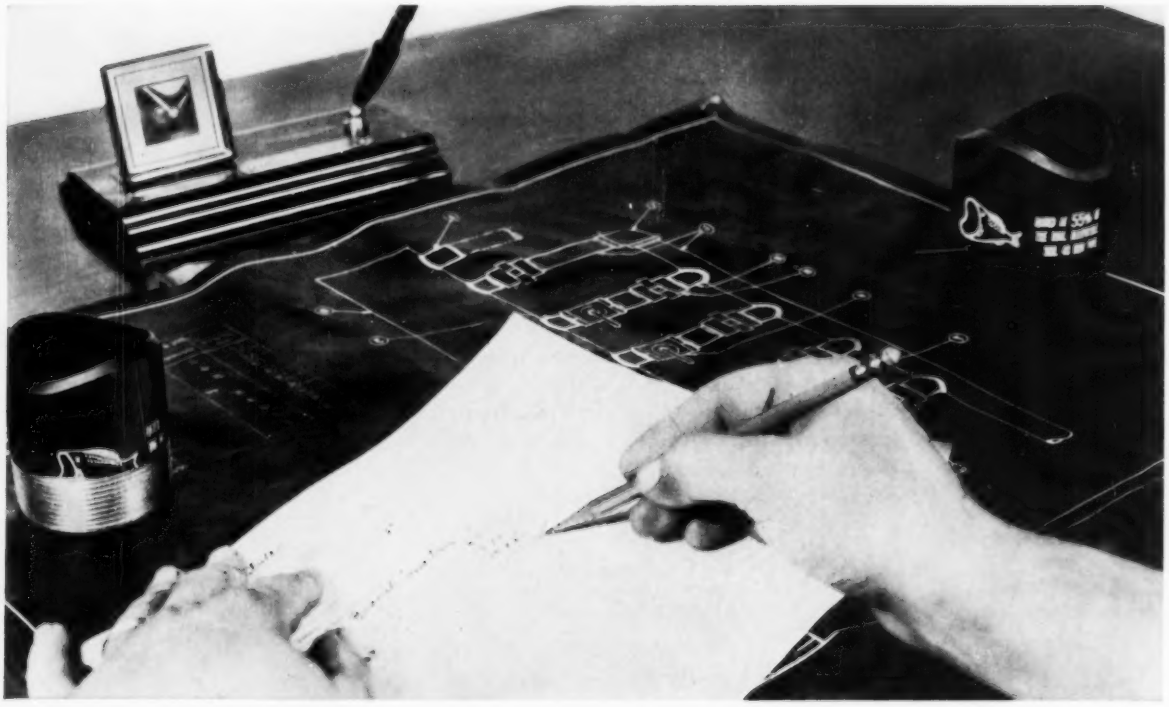
NEW W-S FISHMOUTH BRANCH FITTINGS

Typical Cost: Only 81¢ for 2 inch size for run pipe to 36 inches!

You bid for the job. Stayed late nights to get your bid low. Now the job is yours. But—where's the profit? You have to squeeze on materials and time to make it. Buy cheap—work fast. The old story.

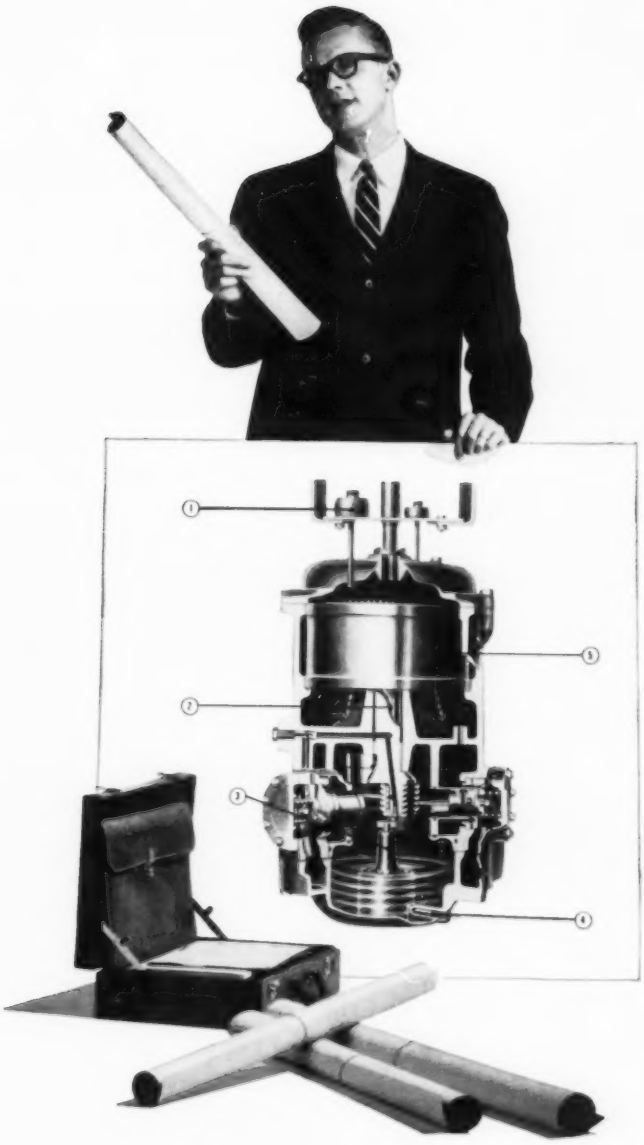
But here's a new story. Figure your branch connections. Lots of them on every job. This new product, W-S FISHMOUTH—figure it instead of the usual tees, laterals, crosses. Savings are almost unbelievable. Makes the difference between breaking even and getting a profit.

If you send us the coupon, you'll learn more. We'll send a 16-page booklet. Tells the whole story. Shows costs for FISHMOUTH vs. other branch connections.



FORGE AND FITTINGS DIVISION PORTER **H.K. PORTER COMPANY, INC.**

PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Specialty Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION, H. K. PORTER COMPANY de MEXICO S. A.; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.



Here are 5 of the 18 reasons why it pays to pick

Climate by Chrysler

Cooling for comfort? Or cooling a process? Only Chrysler Airtemp SW Liquid Chillers offer so many exclusive engineering advantages. Take the hermetically-sealed radial compressor, for example. You get:

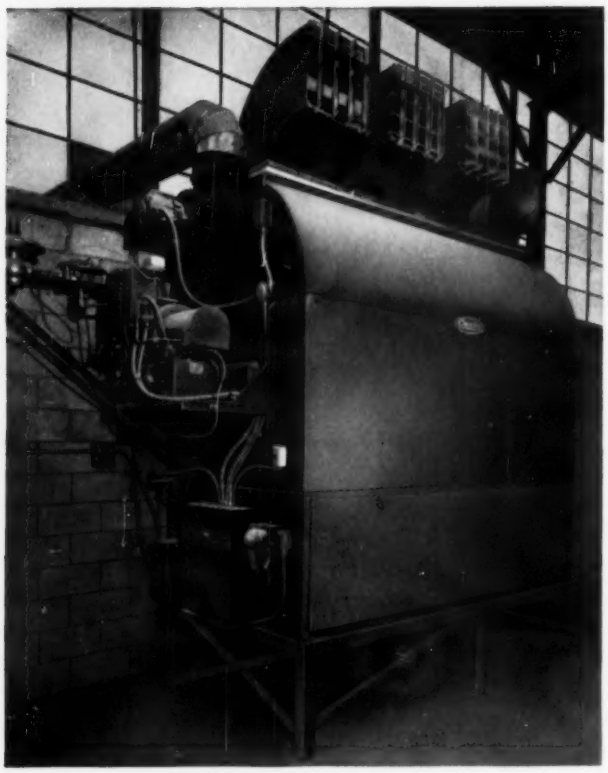
1. *Floating power.* Rubber-in-sheer suspension absorbs vibration. Noise is gone . . . and so are vibration-caused service headaches.
2. *Direct drive.* No belts, no pulleys, no seals to break down. You get greater efficiency, less noise from a more compact package.
3. *Positive lubrication.* Exclusive pressure pump is sealed in a bath of oil. Moving parts get constant lubrication for long, trouble-free life.
4. *Crankcase heater.* Prevents refrigerant from condensing and diluting lubricant. Oil stays clean . . . and always ready to flow.
5. *Sealed-in motor.* Dust-proof for longer service life. Directly connected to dynamically balanced crankshaft to cut weight and operating costs.

The rest of the 18 reasons? They include innerfin direct expansion chiller, automatic control panel, easier installation and . . . But why not get the complete story from your local Chrysler Applied Machinery and Systems sales office. Or write: Airtemp Division, Chrysler Corporation, Dept. Y-119, Dayton 1, Ohio. In Canada: Therm-O-Rite Products, Ltd., Toronto, Ontario.

CHRYSLER AIRTEMP

FIRST WITH THE FINEST IN AIR CONDITIONING

Boat builder gets low-cost comfort with Carrier Heat Diffuser–Direct-Fired



If your problem is finding the best way to heat a large area at low cost, here's what Owens Yacht Corporation's Cutter Boat Co. subsidiary did.

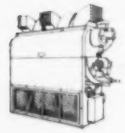
To heat 70,000 square feet of new plant space, Cutter Boat installed two Carrier Heat Diffusers—Direct-Fired to provide 3,000,000 Btus. Both are fired by natural gas. One is used for heating only, the other for heating and ventilating.

Completely self-contained Carrier Heat Diffusers—Direct-Fired, heat or heat and ventilate factories, warehouses and other large buildings at minimum cost. They can be floor-mounted or suspended from wall or ceiling—wherever there's space. No need to worry about special foundations or extra rooms. They heat immediate areas or they can be fitted with ducts to heat other sections.

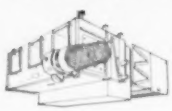
Customers will be sure of top fuel economy with any gas or light or heavy oil. Carrier's "Big Circle" heavy-gauge stainless steel combustion chamber and modern design assure utmost combustion efficiency. Unit sizes range from 300,000 to 2,000,000 Btu hr.

For facts on low-cost heating of large areas with Carrier Heat Diffusers—Direct-Fired, call your Carrier Wholesaler. He's listed in the Yellow Pages under "Heaters—Unit," or write Carrier Corporation, Syracuse, New York.

Carrier offers every type of equipment for any commercial or industrial job



Heat Diffusers – Direct-Fired for all types of fuel



Heat Diffusers for steam and hot water

Unit Heaters for steam and hot water

Gas Unit Heaters and Duct Furnaces

Carrier

AIR CONDITIONING
REFRIGERATION
HEATING
VENTILATING

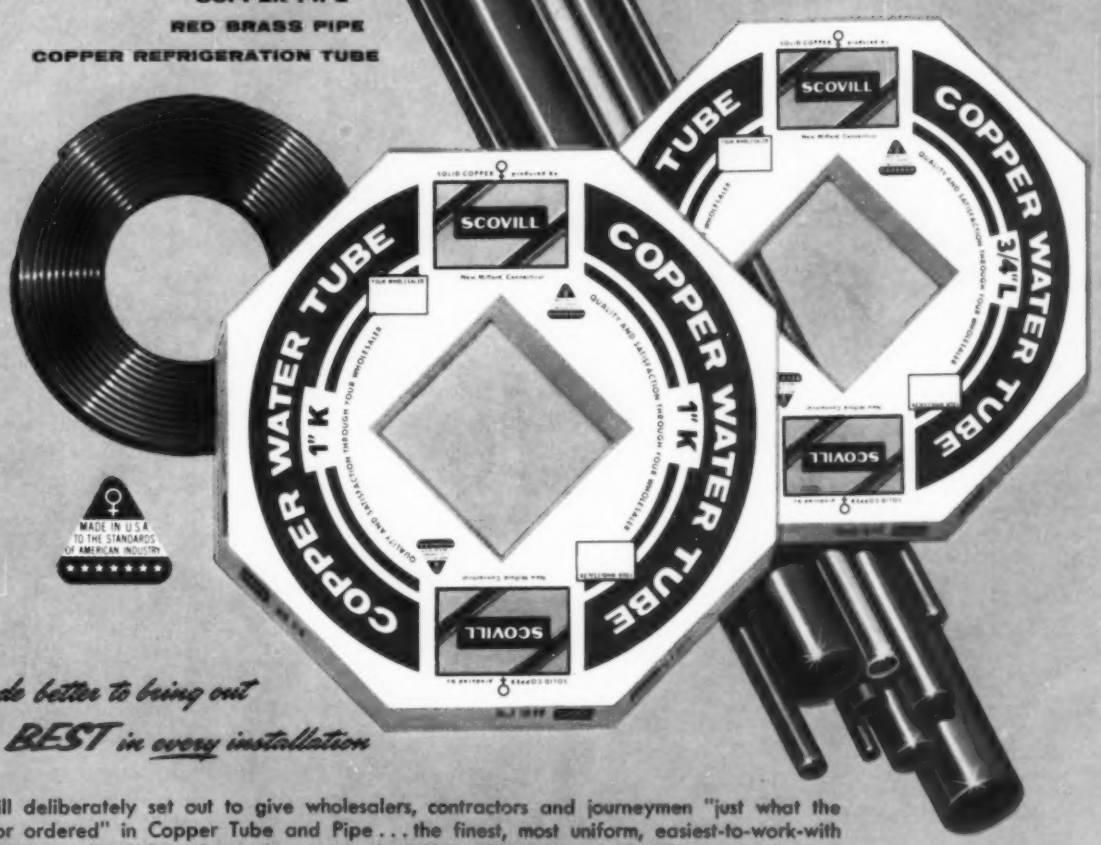
SCOVILL

a **new** standard of **quality** and **service**

under an old and respected name ®

COPPER WATER TUBE K-L-M
COPPER DRAINAGE TUBE (DWV)
COPPER THREADLESS PIPE (TP)
COPPER PIPE
RED BRASS PIPE
COPPER REFRIGERATION TUBE

COPPER WATER TUBE



made better to bring out the ***BEST*** *in every installation*

Scovill deliberately set out to give wholesalers, contractors and journeymen "just what the doctor ordered" in Copper Tube and Pipe . . . the finest, most uniform, easiest-to-work-with materials that fine U.S. craftsmanship can produce. Uniquely packaged, identified and delivered on the job just the way you want them! Scovill built ALL-NEW multi-million dollar tube mills, the most advanced in the industry, for this one purpose . . . with nationwide Scovill sales and service . . . yours to command. Place an order today . . . you'll become our lifelong customer tomorrow.

SCOVILL MANUFACTURING COMPANY • COPPER TUBE MILL PRODUCTS, WATERBURY, CONN.

12SC70

Radiant Ceiling News

With Burgess-Manning Ceilings — Your Building Is Better — Your Building Budget No Bigger

A Leader Chooses a Leader

A world leader for 50 years in the design and manufacture of calculating machines, Marchant Calculators Division of Smith-Corona Marchant Inc., has contributed an almost endless number of innovations and advancements in calculator design and operation. Among them are:

America's first mechanical calculator.

America's first electrically—powered calculator.

High-speed proportional gear principle and mechanism.

America's first calculator of streamline design.

The world's first and only calculator that sets all decimal points automatically.

Unique back transfer mechanism that takes back-tracking out of multi-factor calculations.

As contributors to increased efficiency and greater accuracy in figure work, and time saving ease of machine operation, Marchant executives are deeply conscious of the advantages of environmental comfort to people whose work requires thought and concentration. In planning their new headquarters and factory, they sought the most desirable method of providing comfortable surroundings for the Marchant staff.

Their choice was the Burgess-Manning Radiant Acoustical Ceiling. Radiant cooling and heating most closely matches the natural body demand for heat loss control—the key to thermal comfort—and the ceiling also supplies the best possible in practical work space acoustics.

Sixty-five thousand square feet of office space are thermally and accoustically controlled through the Burgess-Manning Ceiling. The entire structure, which includes the factory, was designed by Architect Albert Roller. It was erected by the Dinwiddie Construction Co. The Burgess-Manning Ceiling was installed by Cramer Acoustics.

The new headquarters and factory of Marchant Calculators Division of Smith-Corona Marchant Inc., Oakland, Calif. Radiantly cooled and heated by the Burgess-Manning Ceiling.

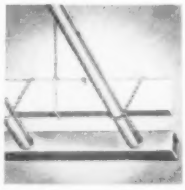
A section of Marchant's accounting division, clerical area. Incorporating thermal functions in the ceiling recovers for practical use valuable floor space otherwise wasted by heat distributing devices.

Radiant comfort for the General Sales Manager is supplied by the Burgess-Manning Ceiling.

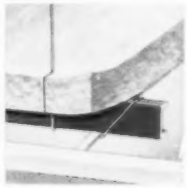
Basically Simple Construction of Burgess-Manning Radiant Acoustical Ceiling

1. Suspension Grid
The suspension grid of $1\frac{1}{2}$" channels on 4 ft. centers is not unusual.

2. Water Circulating Coil
The grid type coil is made from pre-fabricated headers to which $\frac{1}{2}$" laterals are welded. A sinuous type coil can be used where conditions make it desirable. It hangs from the suspension grid.



3. Acoustic-Thermal Insulation Blanket
The non-combustible sound-absorbing blanket, with the required noise reduction coefficient, is laid on top of the suspension grid.



4. Snap-On Panels
Heavy gauge perforated aluminum panels of the proper thermal conductivity are attached directly to the water circulating coil.

Write for descriptive Burgess-Manning Catalog No. 138-2H

3 Heating Cooling Acoustical

BURGESS-MANNING COMPANY

Architectural Products Division

749 East Park Avenue, Libertyville, Illinois

SEE OUR CATALOG IN SWEET'S ARCHITECTURAL FILE OR WRITE FOR COPY

New Bulletin from PENN VENTILATOR...

GIVES ALL THE FACTS ON THE MODERN WAY TO CURB

Leading Manufacturers of Powered and Gravity Roof Exhausters and Accessory Equipment for over 30 years.

Bulletin SCE-89 contains all the information you'll need for quicker, less costly curbing operations. You'll learn why Penn Ventilator's new self-flashing extruded aluminum Sonotrol Curb eliminates field errors, cuts out tiresome coordinating, flashing and waiting . . . how it can be installed in just a half dozen uncomplicated steps.

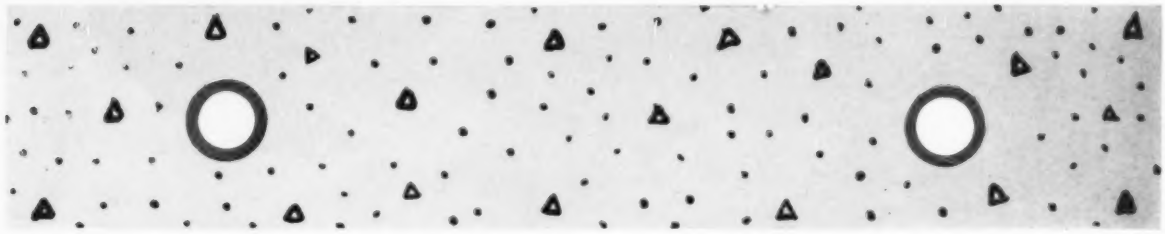
Further, you'll learn how the acoustically insulated Sonotrol Curb helps to blanket and absorb sound waves. Complete construction details are graphically illustrated. And engineering data and suggested specifications are spelled out.

Why not send for your copy of this new extruded aluminum Sonotrol Curb Bulletin. Of course, there's no obligation. Write today to Penn Ventilator Co., Inc., Philadelphia 40, Pa.

PENN VENTILATOR CO., INC.
GOODMAN & ALLEGHENY, Philadelphia 40, Pa.
Representatives and Distributors in Principal Cities
Charter member of AMCA

PENN VENTILATOR CO., Inc.
Goodman & Allegheny, Philadelphia 40, Pa.
Please send me Bulletin SCE-89—"Self-Flashing Extruded Aluminum Sonotrol Curb."
Name_____
Firm_____
Address_____
City_____ Zone_____ State_____

4-D WROUGHT IRON PIPE



FOR SNOW MELTING AND RADIANT HEATING SYSTEMS

PROPOSAL FOR HIGH STRENGTH, CORROSION-RESISTANT INSTALLATIONS

New 4-D Wrought Iron has increased corrosion-resistance, improved mechanical and physical properties. It was achieved by substantially increasing the deoxidation of the base metal, slightly increasing the phosphorous content and using a more siliceous iron silicate.

Write for new 4-D Wrought Iron literature and specific technical information. A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

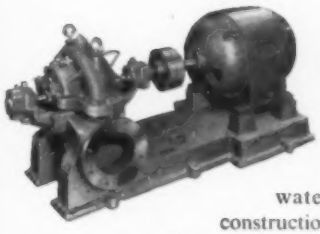
PIPE: THE MOST IMPORTANT SINGLE COMPONENT—Pipe for snow melting and radiant heating systems *must* resist corrosion. It is only accessible for repairs at considerable cost and inconvenience. Any leaks that might result are frequently difficult to locate with any accuracy. It is also virtually impossible to avoid some rough handling during the course of fabricating and installing such systems. So, strength is another piping must.

EXPANSION COEFFICIENTS AND WORKABILITY—Pipe is exposed to wide temperature ranges in these services. So there's always the possibility of unequal expansion damaging surrounding material. The coefficients of 4-D Wrought Iron and concrete are identical. This minimizes the possibility of concrete cracking due to thermal expansion. Additional advantages of 4-D are: good bending properties and the sound, durable welds that can be obtained as a result of its self-fluxing action.

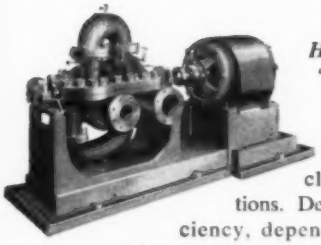
SUITABILITY OF 4-D WROUGHT IRON—4-D Wrought Iron is corrosion-resistant, strong, compatible with structural materials over wide temperature ranges, and easy to fabricate. There is *no* "or equal." Historically, the *first* snow melting system in the U.S. was Wrought Iron: designed 34 years ago for Rochester Gas & Electric Corporation, Rochester, N. Y. No failures, ever. The *first* radiant heating system in the U.S. was likewise Wrought Iron: designed in 1938 for Frank Lloyd Wright's famed S. C. Johnson & Son Office Building in Racine, Wisconsin.

BYERS 4-D WROUGHT IRON

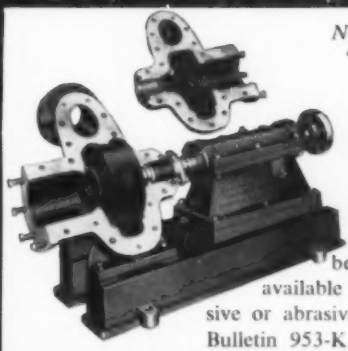
HOW MUCH WILL IT COST YOU



Clear Water Pumps: "Buffalo" Double Suction Pumps assure maximum efficiency in clear water service. Rugged construction provides long life with minimum maintenance. 10 to 14,000 gpm capacities. Write for Bulletin 955-R.



High Pressure Pumps: "Buffalo" Multi-Stage Pumps are ideal for boiler feed and other clear water applications. Designed for top efficiency, dependability, long life. These husky pumps operate against heads as high as 1500 ft., in capacities to 900 gpm. Write today for Bulletin 980-D.



Non-Clogging Pumps: "Buffalo" Diagonally Split-Shell Pumps are specially designed for moving high consistency liquids. Down-time, wear and wedging are reduced. Rubber-lined models are available for pumping corrosive or abrasive liquids. Write for Bulletin 953-K.

Heat Transfer Pumps: These special "Buffalo" pumps are engineered for handling high-temperature liquids. Rugged construction includes special alloys, water-cooled bearings and special packing. Single suction, solid shell design is highly efficient. Write for full details.

Chemical Liquid Pumps: These special "Buffalo" Pumps are engineered for severe service in handling most corrosive, abrasive or high consistency liquids. Ten special types are available in a variety of trim. Write for Bulletin 982-A.

NOW TO INSTALL "BUFFALO" PUMPS?

How "Buffalo" Pumps Can Save You Money Right Away: "Buffalo" offers a broad line of pumps. This means you can usually choose the right pump to fill almost every liquid-moving need. With "Buffalo" Pumps you pay only for the type, size and capacity required — no more. This often means substantially lower initial cost.

How "Buffalo" Pumps Can Save You Money Over the Years: "Buffalo" Pumps are engineered for peak hydraulic efficiency. This gives you consistently lower pumping costs. "Buffalo" Pumps are ruggedly built throughout. Extra heavy-duty components reduce maintenance costs over a longer productive life span. "Buffalo" Pumps are designed for quick, easy access to inner parts. Thus routine maintenance costs are lower. "Buffalo" Pumps feature parts interchangeability. This means further savings in reduced parts inventories.

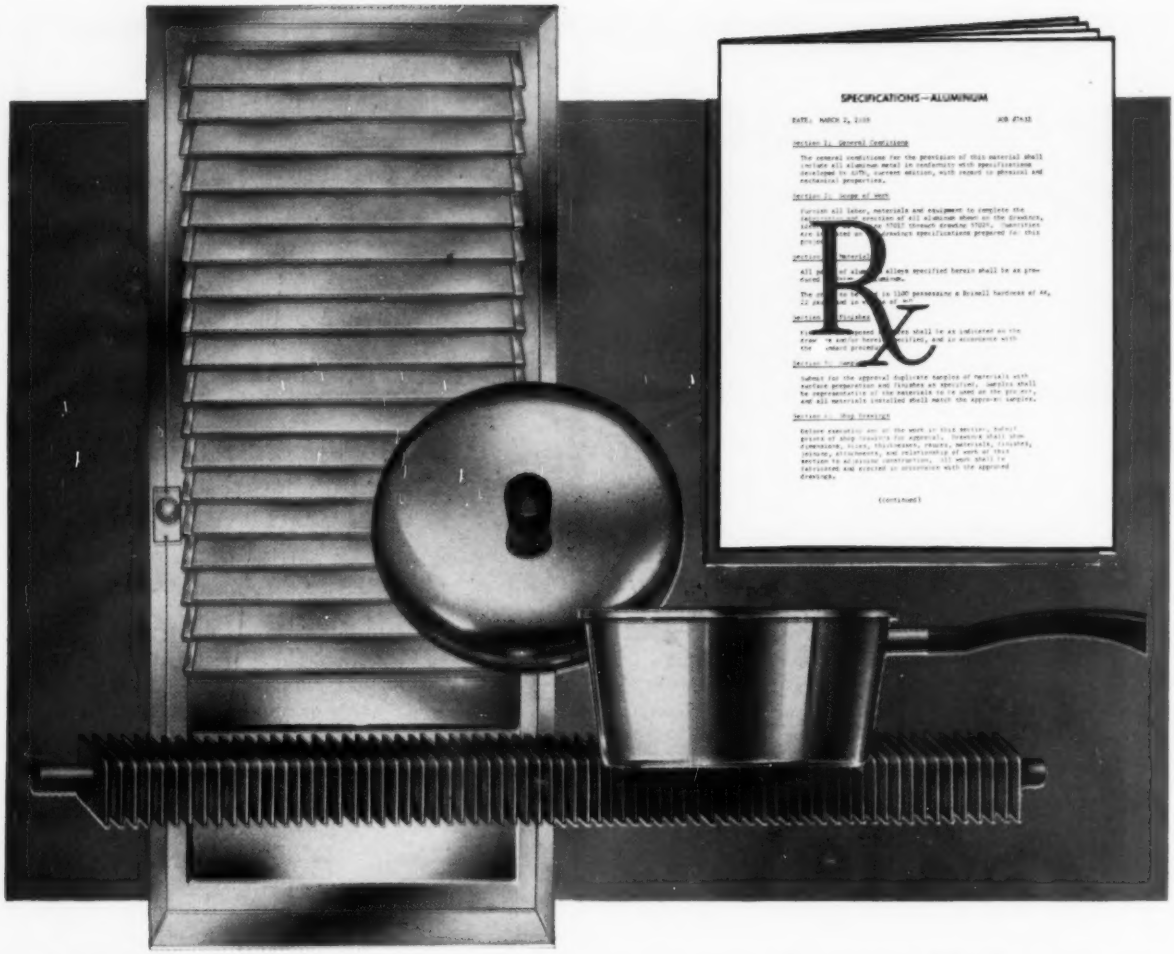
Your nearby "Buffalo" Engineering Representative will be glad to help you choose the pumps that will most economically fill your needs. Phone him today, or write us direct.

"Buffalo" PUMPS

BUFFALO PUMPS
Division of Buffalo Forge Co.
171 Mortimer St. Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



Aluminum by Prescription from Fairmont

When you specify Fairmont for your aluminum requirements, we like to go one step beyond your formal specification data. Whenever possible, we want to know all about the exact product you will be fabricating.

At Fairmont, we stand ready to meet all the standards you specify, but we like to add the benefits of our 32 years of experience in supplying aluminum for such diversified products as saucepans and awnings, bottle caps and chemical equipment, storm doors and fan blades, TV cabinets, name plates and cooling coils.

Be sure the aluminum you buy is the best for your product. Let Fairmont Aluminum *prescribe* the next lot of aluminum for you. You'll find it will be "Very truly yours."

For a free copy of Fairmont's latest technical bulletin, write or call today.

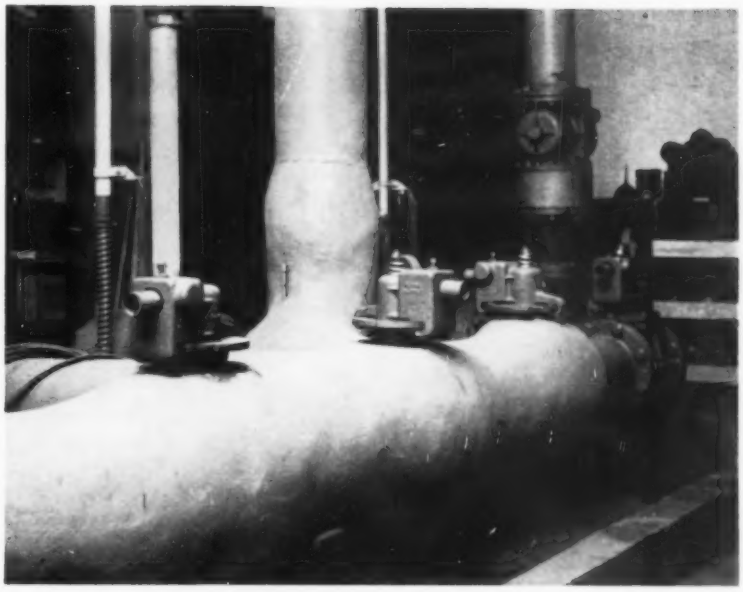
Sales Offices in Principal Cities

FAIRMONT Aluminum Company

Subsidiary of Cerro de Pasco Corporation

Dept. H-10 Fairmont, West Virginia

DeZURIK ..the BEST valves for air conditioning because.....



THEY'RE VERSATILE BEYOND COMPARE!

DeZurik Valves are "versatile specialists" on air conditioning because they do so many things so well! When used as balancing valves, they provide excellent throttling and drip-tight shut-off. They're also used as shut-off valves on chilled water, cooling tower water, condenser lines, etc.

They can be furnished with actuators for automatic operation. And they can be supplied in 3-way or 4-way styles for switching or blending service.

The valves pictured here (installed by Riggs Distler Company, New York) are on chilled water lines in the U. S. Fidelity and Guarantee Building in New York.

On this, as on every air conditioning installation, DeZurik Valves offer more . . . . in versatility, in performance, in long life, in maintenance-free operation.

Available in sizes ½" thru 20", in 2-way, 3-way or 4-way models, with manual, on-off or positioning actuators. For more details, see the DeZurik representative in your area, or write for a complete list of installations.

DeZURIK CORPORATION
SARTELL, MINNESOTA

Only DeZurik Valves give you all these advantages:

1. Easy Operation
2. Drip Tight Shut-off
3. Low Pressure Drop
4. Best for Balancing
5. Low Installation Cost
6. No Maintenance
7. Proved Record of Dependability
8. Compact Size
9. Economically Priced
10. Versatility beyond compare

TO MEET THE GROWING DEMAND FOR QUALITY

SPECIFY LUNKENHEIMER VALVES

Today's conditions demand valves that *last*. And for good reason. When an industrial, commercial, or institutional building goes up, a wise investment in quality valves, particularly when quality costs no more, is returned many times over in lower maintenance costs. That's why preference for Lunkenheimer Valves is at an all-time high. They are unmatched in design. They are the *only* valves that offer *all* the performance features demanded by today's value-conscious buyer. For nearly a hundred years, Lunkenheimer Valves have been the leaders in lower maintenance cost . . . and Lunkenheimer special patented features are unmatched. If you are interested in the highest quality at a cost you can't find on any price list, write The Lunkenheimer Company, Cincinnati 14, Ohio

LUNKENHEIMER QUALITY

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

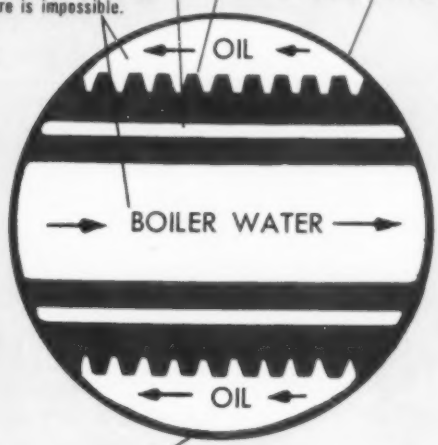
HOW TO USE BOILER WATER DIRECTLY IN A NO. 6 FUEL OIL HEATER WITHOUT DANGER OF SYSTEM CONTAMINATION

THERMO-FILM* —the safety barrier heat transfer liquid—is extremely thin to maintain maximum heat transfer.

EXTENDED SURFACE of outer tubes substantially reduces size and weight of heater.

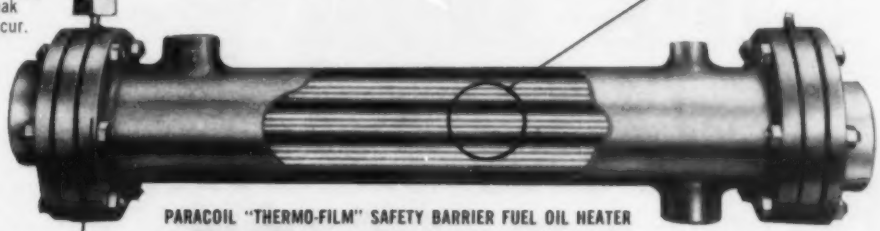
COMPLETE ISOLATION of boiler water and fuel oil is accomplished by a coaxial tube assembly, with heat-transfer liquid between inner and outer tubes. **Boiler contamination in event of oil tube failure is impossible.**

100% COUNTER FLOW results from straight tube construction. Heated oil exits at end where boiler water enters at its highest thermal head—another design feature assuring maximum overall heat transfer.

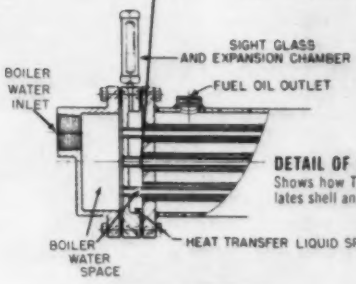


This Paracoil Thermo-Film* fuel oil heater permits direct use of boiler water and fuel oil in the same shell. Design safely isolates oil and water circuits. Oil leak cannot contaminate boiler stream. This diagram explains the heater's remarkable efficiency.

IMPROVED INDICATOR immediately reveals presence of oil in heat transfer liquid in the unlikely event a leak should occur.

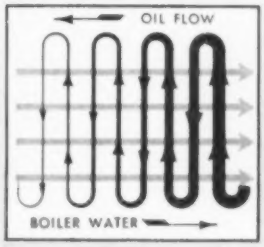


PARACOIL "THERMO-FILM" SAFETY BARRIER FUEL OIL HEATER
Low pressure model—for gravity or forced circulation of boiler water. Provides maximum capacity with minimum size. Also available but not shown: high pressure models, for use with high temperature hot water or steam as the heating medium.



DETAIL OF END CHAMBER
Shows how Thermo-Film* isolates shell and tube side fluids.

INTERNAL TURBULENCE
Oil, with low pressure loss, passes in baffled flow across heating tubes — further increasing heat transfer rates and reducing bulk of the heater. (Thickness of oil flow line represents viscosity).



*Trade Mark Reg., U.S. Patent Office

Paracoil HEAT TRANSFER EQUIPMENT

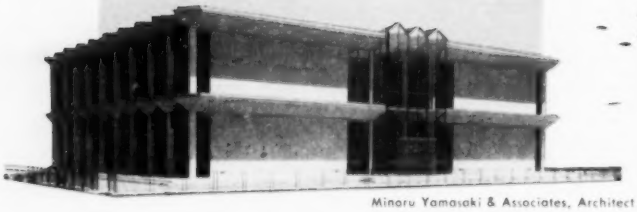
For details, write for Bulletin 60-N

DAVIS ENGINEERING
(A Division of American Metal Products Company)
520 Main Avenue, Wallington, N. J.

AN amp SUBSIDIARY

because of dorex®...

THEY BREATHE BETTER AIR *at* WAYNE STATE UNIVERSITY



Minoru Yamasaki & Associates, Architect

Seen as a sign of the school's attitude toward advancing the cause for higher learning, Wayne's new AIA award-winning McGregor Community Conference Center has imposing significance. And just as significant is the careful attention given to the comfort needs of the Center's many occupants.

An installation of 44 high efficiency Dorex activated carbon air purification cells purges recirculated air of irritants and purifies it for sanitary re-use in the Center's large air conditioning system.

The reputation of Dorex for exceptional efficiency and adaptability is backed by more than 25 years of practical experience in the design and manufacture of air purification equipment. And a systematic replacement service—offered exclusively by Connor—guarantees the continuous, effective operation of every Dorex installation.

As shown here, the Dorex installation at Wayne is assembled in one central location. Activated carbon cells are arranged 11 wide by 4 high, and are protected by high efficiency dust filters. By this arrangement, which demonstrates the installation flexibility of Dorex units, space-conservation and exceptional purification efficiency are achieved.

CONNOR... for Constant Comfort Conditions

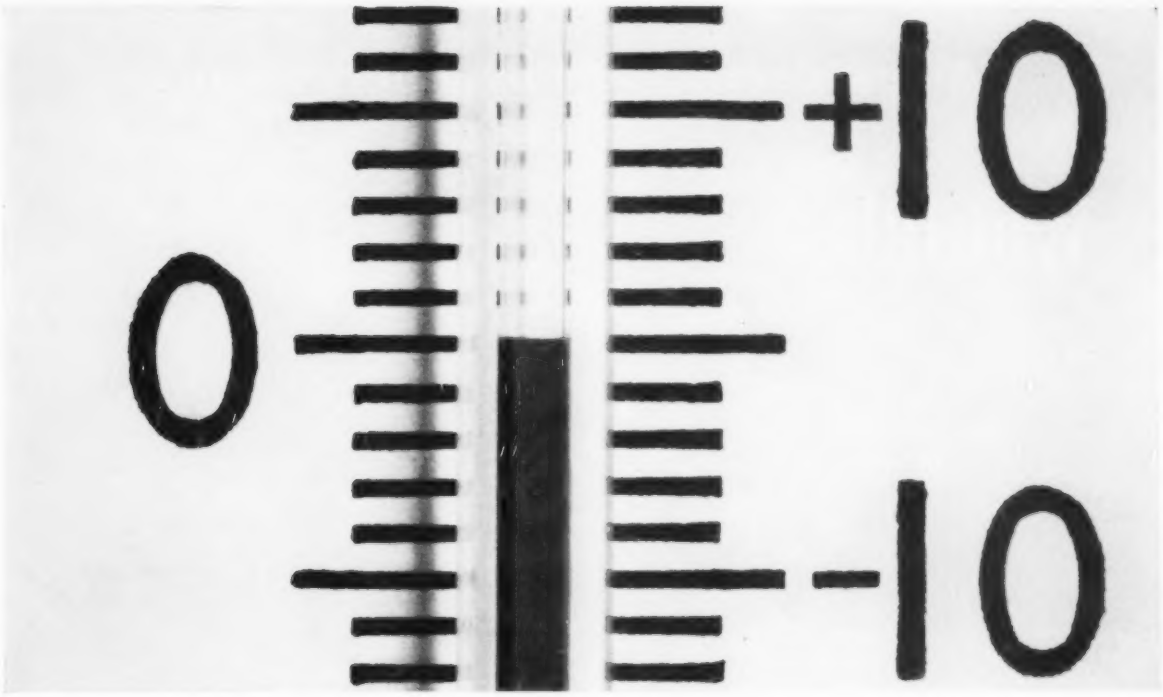
For complete information on Dorex equipment, request new Bulletin 108A.

CONNOR ENGINEERING CORPORATION

DANBURY • CONNECTICUT

CONNOR ENGINEERING CORPORATION

dorex® air recovery



Zero in on Frozen Foods with genetron®

SUPER-DRY REFRIGERANTS

From packing house to supermarket, actual zero temperature (or lower!) is *always* needed to maintain freshness, quality and flavor of frozen foods and to prevent spoilage. That's why you can't take chances. Whatever way your frozen foods are transported—by rail, truck or on board ship—however they are packed, stored or sold—they need the sure protection of modern refrigeration equipment . . . and dependable "Genetron" fluorinated hydrocarbon refrigerants.

"Genetron" Super-Dry Refrigerants are available from refrigeration and air-conditioning wholesalers from coast to coast. See your wholesaler. Insist on "Genetron" in *all* your frozen food refrigeration equipment!

Quick Facts on "Genetron" Super-Dry Refrigerants

- Guaranteed exceptionally low moisture content
- Noncorrosive to standard equipment materials, nontoxic, nonflammable, stable, safe
- Critical and freezing points well outside range of operating uses
- Solvent action on oil helps prevent solidification or congealing of lubricant; aids in lubrication of equipment; generally miscible with oil
- Freely interchangeable and may be mixed in any proportions with comparable fluorinated hydrocarbons meeting the same strict refrigerant specifications

genetron 11 ORANGE LABEL CCl_3F TRICHLOROMONOFLUOROMETHANE
genetron 12 WHITE LABEL CCl_2F_2 DICHLORODIFLUOROMETHANE
genetron 22 GREEN LABEL $CHClF_2$ MONOCHLORODIFLUOROMETHANE
genetron 113 PURPLE LABEL $C_2Cl_3F_3$ TRICHLOROTRIFLUOROETHANE
genetron 114a BLUE LABEL $C_2Cl_2F_4$ DICHLOROTETRAFLUOROETHANE

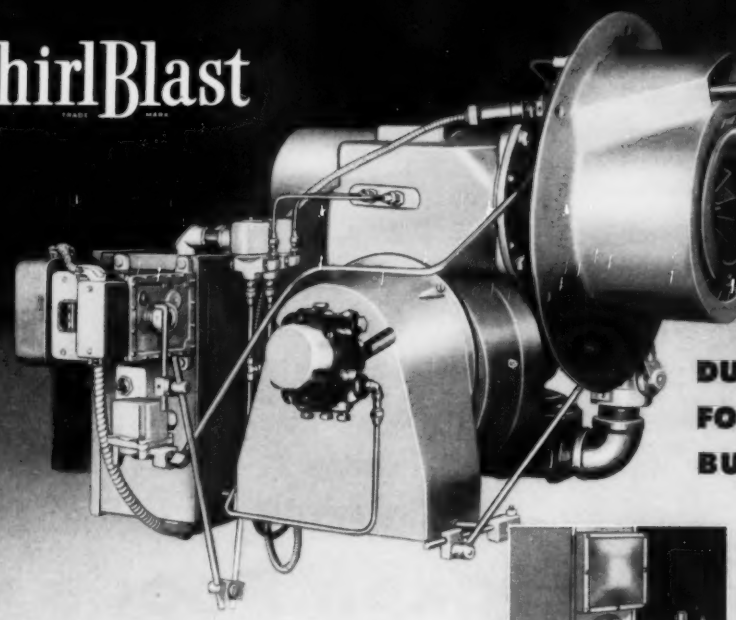
Basic to America's Progress

Allied Chemical

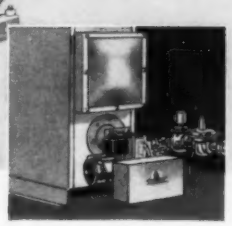
GENERAL CHEMICAL DIVISION
40 Rector Street, New York 6, N. Y.

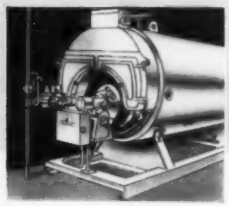
A new development by Iron Fireman

WhirlBlast



DUAL FUEL FORCED DRAFT BURNER





Makes firebox boilers super-efficient

NO SMOKE

Burns clean in less than 10 seconds. The WhirlBlast flame is brilliantly clean almost instantly, and stays clean. Although accepted standards of oil firing allow a 15 minute warm-up period, during which time smoke is tolerated, the Iron Fireman WhirlBlast burner is clean in seconds. Smoke and soot are unburned fuel—completely wasted by smoky starts.

NO STACK

Needs only an exhaust vent. Boilers with conventional burners require from 30 to 80 feet of stack or an induced draft fan. Sealed steel firebox boilers with WhirlBlast burners require only a small exhaust vent.

CONSERVES BOILER HEAT

Standby loss is almost nil. The highly efficient WhirlBlast burner does not need a refractory combustion chamber to "support combustion." Consequently there is no brickwork to store heat to be wasted during "off" periods. Standby heat loss is reduced to an insignificant minimum.

CUTS COSTS

Low fuel bills; low maintenance. Efficient combustion and low standby loss conserve fuel. Elimination of smoke and soot means no fouled boiler tubes, no carboned nozzles or electrodes; no refractory maintenance expense.

A COMPLETE PACKAGE

No special skill to install, adjust, service or operate. The WhirlBlast burner (for gas, oil or dual-fuel combination) comes from the factory fully wired and tested. Bolts to boiler front with firing head through fire door. No special combustion chamber or firing pit needed. Exceptional installation saving.

Send coupon for further information.

IRON FIREMAN®

AUTOMATIC FIRING EQUIPMENT
FOR HEATING, POWER, PROCESSING

IRON FIREMAN MANUFACTURING COMPANY
3165 W. 106th Street, Cleveland 11, Ohio
(In Canada, 80 Ward Street, Toronto, Ontario)

Please send me more information and specifications on the Iron Fireman WhirlBlast burner.

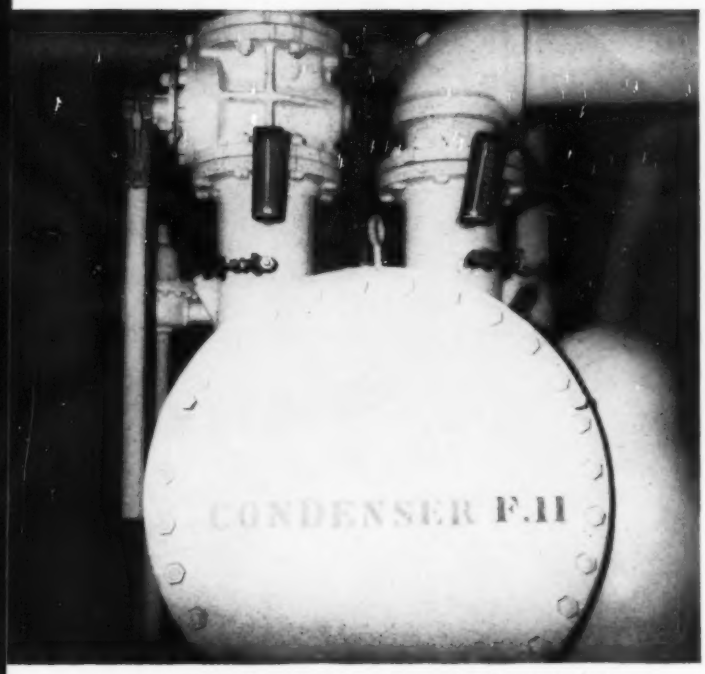
Name _____

Firm _____

Address _____

City _____ Zone _____ State _____

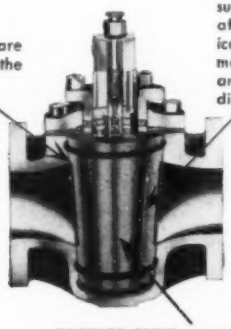
HOW TO GET PERFECT BALANCE ON CHILLED WATER LINES and throttle or shut-off with one valve



Rockwell-Nordstrom fig. 143, 200 lb. valves on chilled water circulation system at 300,000 sq. ft. fully air conditioned manufacturing plant in Texas.

More and more air conditioning designers are relying on Rockwell-Nordstrom lubricated plug valves for perfect, one-valve control of chilled water systems. On any size line, these *lubricated* valves will give you design and operating advantages that you can't expect from ordinary valves. A few of these advantages are shown below. For details, write for literature; or better yet, talk to a Rockwell field engineer.

1. *Perfect Balance:* Plug is smoothly, quickly positioned . . . wrench shows degree of throttle.
2. *Throttle Shut-Off:* Pressurized *lubricant* sealing that can't "wear out," plus unexposed seating, assure positive shut-off. Seats never exposed to line, eliminating main cause of throttle valve failure.
3. *No Chance Of Chatter:* The solid, *tapered* plug is seated perfectly in valve body . . . no chatter even after years of throttling service.
4. *Compact:* No bonnet cavities or rising stem member . . . saves weight, space.
5. *Sizes To 36":* Chill water lines above 8" are no longer a problem, you get size and pressure rating you need to meet *your* design requirements.



UNEXPOSED SEATS are fully protected from the line flow at all times.

LUBRICANT SEALING assures positive shut-off even after years of heavy service. The lubricant film also makes operation smooth and easy at full pressure differential.

TAPERED PLUG assures positive seating and permits constant contact between the plug and body. Vibration is eliminated during opening, closing and throttling.

Rockwell-Nordstrom is the *original* and world's most complete line of lubricated plug valves, plug valve accessories, and lubricants. Available through leading suppliers everywhere. Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

ROCKWELL-Nordstrom VALVES
another fine product by
ROCKWELL

SEND FOR COMPLETE DETAILS TODAY

Rockwell Manufacturing Company
Pittsburgh 8, Pa.

( ) Please send Bulletin on valves for heating, piping and air conditioning installations.

( ) Please have your representative call.

Name_____ Title_____

Company_____

City_____ Zone____ State_____

The Top Quality **STEEL PIPE**

FOR GENERAL USE...SPANG® CW®

. . . produced under quality control conditions for all types of plumbing, heating, air conditioning and sprinkler systems. Thoroughly tested and inspected before shipping to assure fast, easy, time-saving installations. Available in black or galvanized, threaded and coupled or plain ends, in a full range of sizes.

FOR SPECIAL USE... SPANGRID

. . . especially produced for long life in radiant heating, ice rinks, snow melting and refrigeration systems. Excellent bending and welding characteristics. Uniform throughout. Rugged construction for trouble-free service. Special lengths to meet your requirements.

FOR STRUCTURAL USE... SPANG CW

FENCE AND STRUCTURAL PIPE

. . . approximately 20% lighter than standard CW steel pipe. For fence posts, fence supports, railings, playground equipment, farm equipment, awnings and many other uses. Strong, durable, easy to work with. Available in black or galvanized, plain ends, sizes 1″ to 2″.

You get top-quality when you specify SPANG Steel Pipe. Steel pipe gives you that extra plus in service, workability and long life. It pays to specify steel pipe . . . it pays to specify SPANG!

SPANG CW STEEL PIPE

THE NATIONAL SUPPLY COMPANY

Subsidiary of Armco Corporation

TWO GATEWAY CENTER, PITTSBURGH, PA.

SINCE 1905

U.S.FLEX

*U.S. REG. T.M.

KEFLEX

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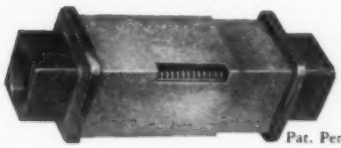
Stainless Steel Bellows Type Expansion Compensators
Braided Bronze Flexible Connectors

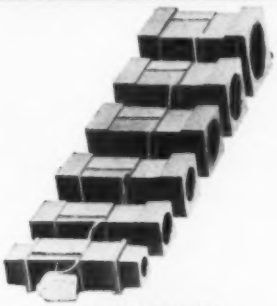
TYPE 7 Q WITH BRASS FEMALE THREADED ENDS
Maximum Pres. 300 PSI Maximum Temp. 800 F



Pat. Pend.

TYPE 7Q-T WITH COPPER TUBE ENDS
Maximum Pres. 200 PSI Maximum Temp. 300 F

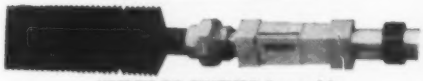
Pat. Pend.



7 Q QUADRA-SIDE EXPANSION COMPENSATORS

"BMH" Flexible Connector

"USF" Vibration Absorber



KEFLEX 7Q FINTUBE Assembly

DUAL KEFLEX 7Q With Anchor Base

KEFLEX EXPANSION AND VIBRATION ASSEMBLIES

SLOTTED BOLT HOLES

158-12E EXPANSION JOINT

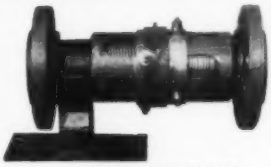
158-15-12E DUAL EXPANSION JOINT

158-15-9E DUAL EXPANSION JOINT

308-14E EXPANSION JOINT

151-2V VIBRATION ABSORBER

301-4-14S VIBRATION ABSORBER

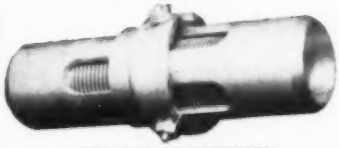


KTO-300-EAB-14E

KEFLEX With KETROL GUIDES

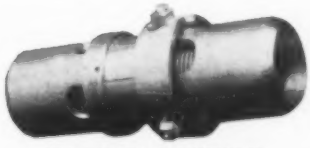
Pat. Pend.

KTO-300-15-CAB-14E

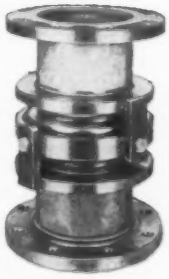


KTO-300-2E EXTENDED

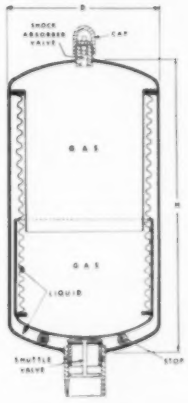
OUTSIDE GUIDES CAGE CONTROLLED



KTO-300-2E COMPRESSED

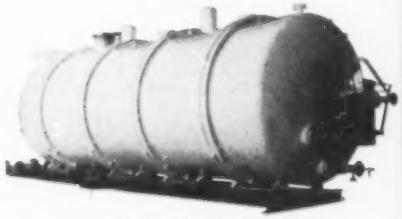


KEFLEX GIMBAL UNIT



TYPE P
KEFLEX PULSCO SHOCK TRAP

TYPE M
KEFLEX MAVE PIPE GUIDE



KEFLEX BELLOWS ON LOX TANK For Vacuum Service

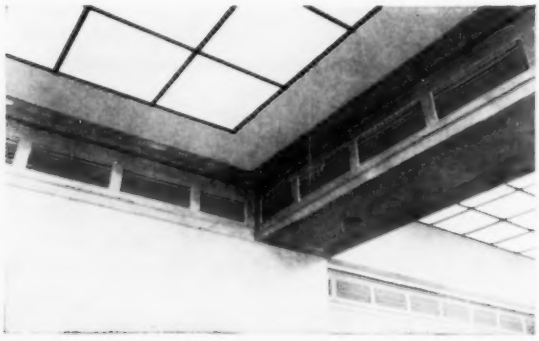
WRITE FOR KEFLEX BULLETINS
A KEFLEX REPRESENTATIVE IS NEAR YOU

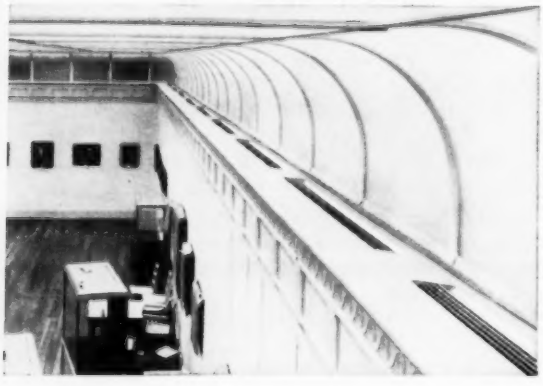
U. S. Flexible Metallic Tubing Co.

Since 1905

KEFLEX MANUFACTURING DIVISION
General Offices—63 Main St., San Francisco 5, Calif.
Factory—Los Angeles
Sales Offices—Agents in Principal Cities of United States and Canada

Draftless Anemostat Air Diffusers at Sterling and Francine Clark Art Institute





The photograph above illustrates an Anemostat Straightline Air Diffuser installation in the gallery design of the Sterling and Francine Clark Art Institute at Williamstown, Mass. The conditioned air is supplied through Straightline Diffusers located on all four sides of the gallery. The diffusers not only draftlessly introduce conditioned air into the gallery, but also blend into the architectural design.

Anemostat, Round, Square and Straightline Diffusers for conventional or high velocity systems are adaptable to a wide variety of architectural designs.

Write for Selection Manual No. 60, which gives data on Anemostat's wide range line of air diffusion equipment.

ANEMOSTAT®

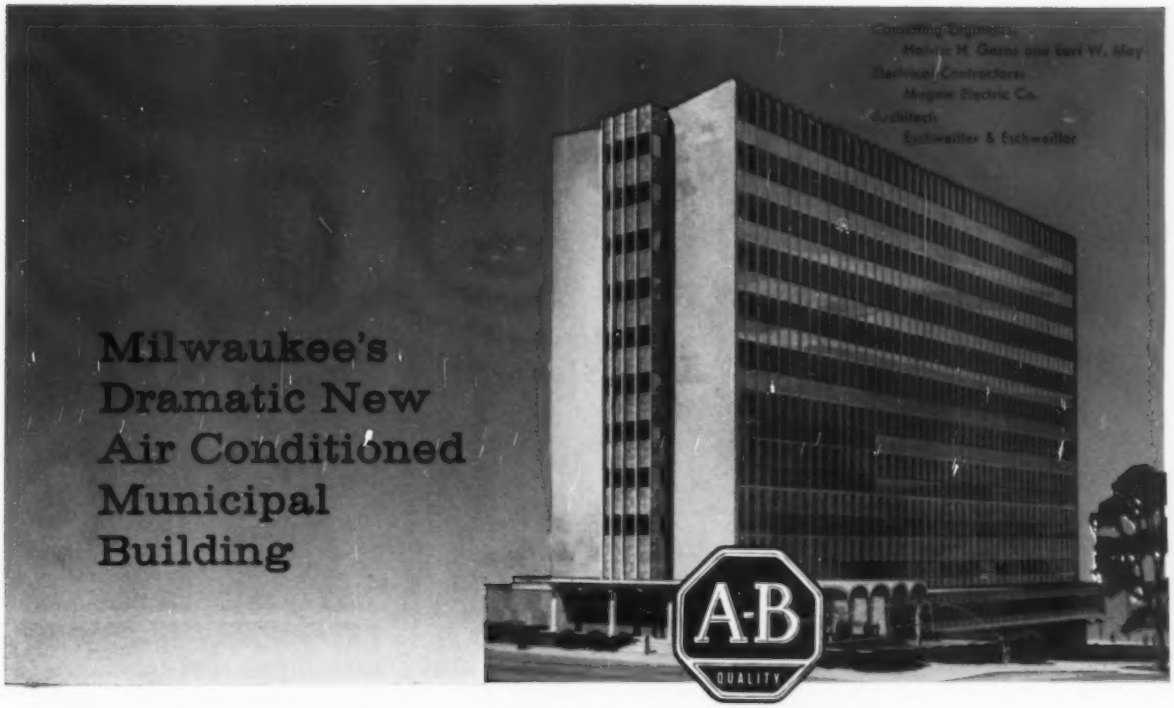
DRAFTLESS *Aspirating* AIR DIFFUSERS

ANEMOSTAT CORPORATION OF AMERICA

10 East 39th Street, New York 16, N. Y.

Representatives in Principal Cities

AC-1358



...controls by **ALLEN-BRADLEY,** *of course*

Allen-Bradley quality motor control is a *natural* in the years-ahead planning that goes into a new building. Its simple ONE moving part solenoid design assures *millions* of trouble free operations. And the double break, silver alloy contacts never need service attention. Build with the future in mind—insist on Allen-Bradley—the motor control of *proven* and *consistent* reliability.

Main Allen-Bradley control panel—consists of Bulletin 798 control center alongside cabinets for compressor motor starters.

This Allen-Bradley Bulletin 798 control center contains the combination starters which are for motors on the auxiliary pumping equipment.

ALLEN-BRADLEY Member of NEMA *Quality* **Motor Control**

Allen-Bradley Co., 1335 S. First St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

steel pipe

keeps the steel blades flying

This blossoming business of community ice skating has grown into a sizeable—and profitable—market. Best assurance of profitability for the installation of an ice-making system is the elimination of costly maintenance and repairs. It's a job that calls for strong, durable *steel pipe.*

With dependable *steel pipe* there's no danger of damaging the refrigerant lines, no bending and sagging. *Steel pipe* has *proved* its place in many applications like this.

Whenever there's a new application, it pays to stay with dependable, time-tested materials. The skating rink is just another example of the many kinds of jobs that *steel pipe* can do *best.*

STEEL PIPE IS FIRST CHOICE

- Low cost with durability
- Strength unexcelled for safety
- Formable—bends readily
- Weldable—easily, strongly
- Threads smoothly, cleanly
- Sound joints, welded or coupled
- Grades, finishes for all purposes
- Available everywhere from stock

INSIST ON PIPE MADE IN U.S.A.

COMMITTEE ON STEEL PIPE RESEARCH

AMERICAN IRON AND STEEL INSTITUTE

150 East Forty-Second Street, New York 17, N.Y.

4 WAYS to get maximum reliability in expansion joints

1 Insist that the corrugated bellows be hydraulically formed. The reason is simple. Whenever bellows are formed by circumferential welding . . . whether by edge, seam or fillet welding . . they will always be subject to premature failure because of stress concentrations at the welds.

2 Be sure the manufacturer maintains a continuous and comprehensive program of endurance testing. This is basic, because of the many variables that affect expansion joint life. Accurate determination of expansion joint life expectancy can only be determined by cycling to destruction.

3 Demand proof that the manufacturer can produce longitudinal welds in the corrugated bellows having the same strength, physical properties and thickness as the parent metal . . . without grinding. A weld that is hard to find is a ground weld. Variations in weld thickness set up points of stress concentration . . . opening the way for premature failure.

4 Check the ability of the manufacturer to supply a team of *competent* design and application specialists to work with your engineers. Check their specific experience in handling critical, complex applications in your field . . . complete to the record of successes or failures behind them, and details of how this experience will be brought to bear on your problem.

At Zallea, none of the many factors affecting expansion joint reliability are left to guesswork . . . including the four vital ones above.

This is reflected in these facts. Zallea material specifications are the most exacting in the industry. Zallea expansion joints are hydraulically formed. Zallea advanced welding techniques insure welds having the same thickness, strength and physical properties as the parent metal. Zallea has done more cyclic testing to destruction than all government agencies and industrial firms combined. Zallea has produced more expansion joints than any other manufacturer . . . offers more application engineering experience.

For all the facts, write for Catalog 56. Zallea Brothers, Taylor and Locust Streets, Wilmington 99, Delaware.

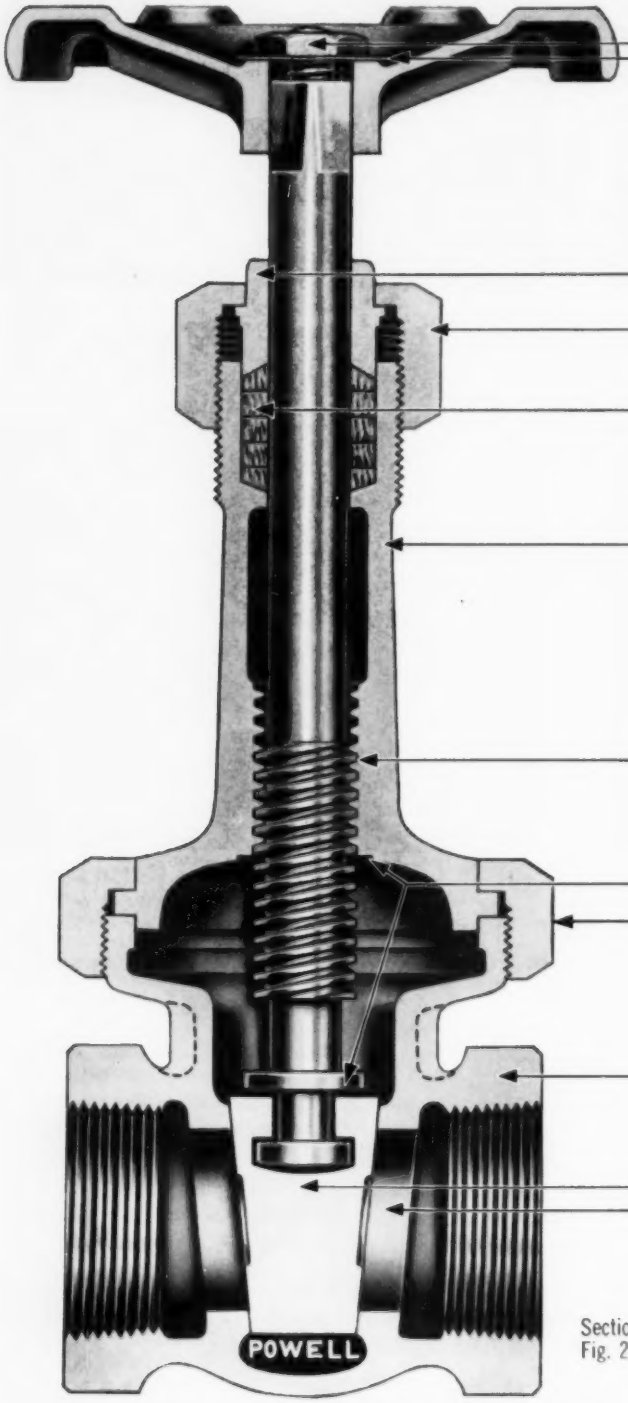
Zallea for maximum reliability

ZALLEA BROTHERS, Wilmington 99, Delaware • World's largest manufacturer of expansion joints

New POWELL Bronze Union Bonnet Gate Valves

for 125 and 150 pounds WSP

Powell's new BRONZE Union Bonnet Gate Valves have many superior features — some of which are outlined here. For complete details, write us for new illustrated circular. Or check with your nearest Powell Valve distributor. Always look to Powell first for all your valve needs.



Handwheel Nut—securely holds malleable iron, non-heating handwheel to the stem.

Identification Plate—gives Figure Number and kind of valve.

Protruding Packing Gland—a Powell feature—compresses the packing, offers additional guidance to the stem, and prevents packing nut from becoming loose and rotating with stem.

Heavy Hexagonal Packing Nut—for holding gland and adjusting packing.

Deep Stuffing Box—holds more than ample amount of high-grade steam packing.

Long Bonnet—cast of high tensile bronze for long service.

Stem—is high tensile bronze, extra heavy, of large diameter, with long Acme threaded section.

Repack-Under-Pressure Seat and Collar—permit valve to be repacked under pressure when fully open.

Octagonal Ring Nut—is deep threaded and tightly holds body-bonnet connection. Affords additional wrenching positions.

Body—a high tensile bronze casting, scientifically designed to provide full flow area through the valve.

Wedges—Interchangeable Solid or Double Wedges are available in rising stem valves. They are held to stem by a "T" slot, and are accurately guided to valve seats by means of integral cast lugs that travel in female guideways in the valve body. Entirely clearing the waterway, full unobstructed flow through is assured.

Ample Space—between seats and end of pipe thread prevents injury to seats when screwing pipe into the body.

Sectional—Union Bonnet Rising Stem Gate Valve
Fig. 2700 (125 pounds), Fig. 2714 (150 pounds).

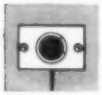
THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

McDONNELL
Flow Switches

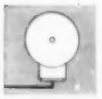
FS4 Series Flow Switch Mounted in a 2 inch Tee

Do you know how many jobs these switches can do?

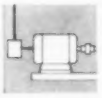
Look at the FS4 Series Flow Switch illustrated here. What you see is a compact, well-built switch that either makes or breaks a circuit (as required) when liquid flows or stops flowing. Yet in this versatile device you have both the most economical way and the most positive way of starting or stopping a signal, an alarm, a motor, a metering device—anything electrically operated. Just to highlight a few uses:—



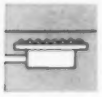
to actuate a signal light—signal an attendant to make the right moves in operating valves, pumps and the like—signal him when flow stops in a water cooled compressor, water cooled bearing and so on.



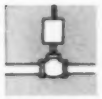
to sound an alarm—when flow stops in a process system or in any water cooled devices.



to start or stop motors—start pumps in sequence in multiple stage flow systems; start standby pumps; stop automatically controlled units if cooling water system fails; stop compressors in cooling systems when flow stops. These are *control* functions, and almost endless.



to start or stop automatic burners—start a booster heater when water draw occurs; stop burner if flow is improperly retarded; make sure of circulation in a boiler before burner is permitted to start.



to actuate metering device—open valve in chemical feeder line; start mixing in secondary line whenever flow starts in primary line.

Think it over! Some of these uses may suggest some related problem the FS4 can solve for you right now. Notice the facts about its construction and service range opposite.

McDonnell quality throughout:

Compact switch with positive snap action. Removable cover and two knockouts for easy wiring. Phosphor bronze sylphon seals assembly leak-tight from line. Paddle made in segments to fit any pipe from 1" through 3". FS4 series, illustrated, is for maximum working pressure 100 psi; maximum temperature, 300° F., in types as follows:

FS4-3 Single pole, double throw switch. Opens and closes two separate circuits with flow. Closes and opens same two circuits with no flow.

FS4 Closes with flow, opens with no flow.

FS4R Opens with flow, closes with no flow.

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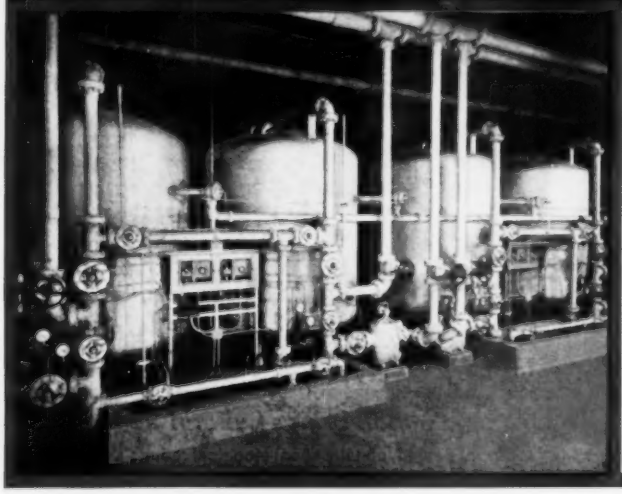

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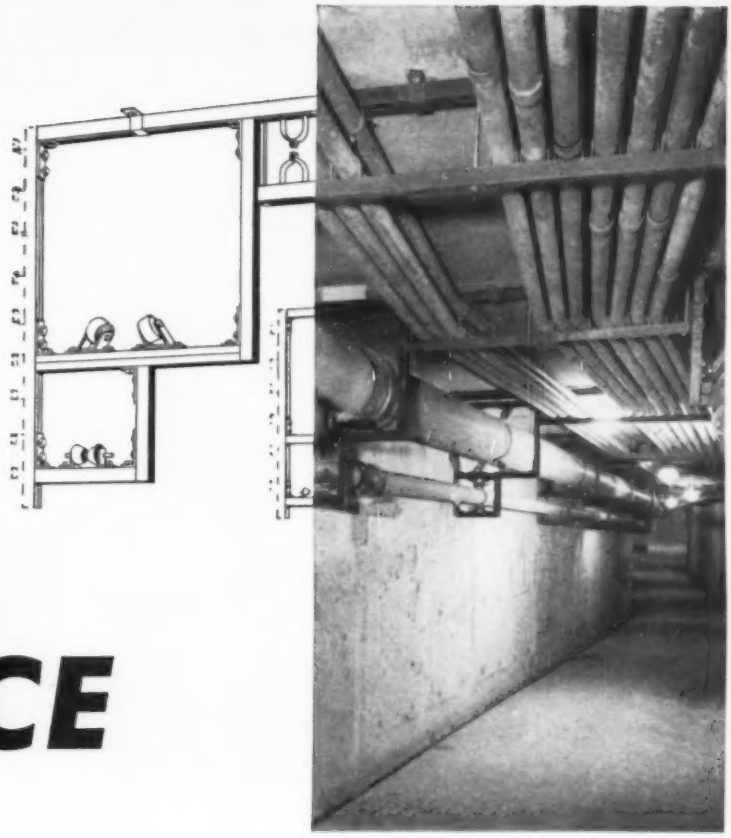

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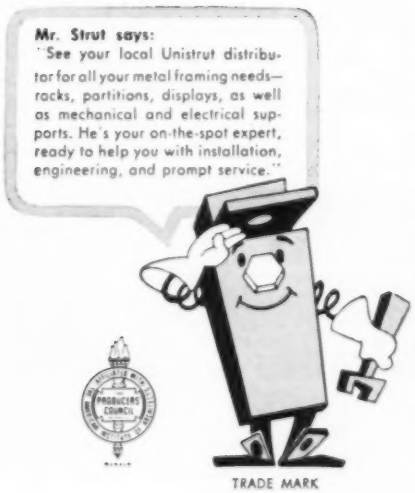
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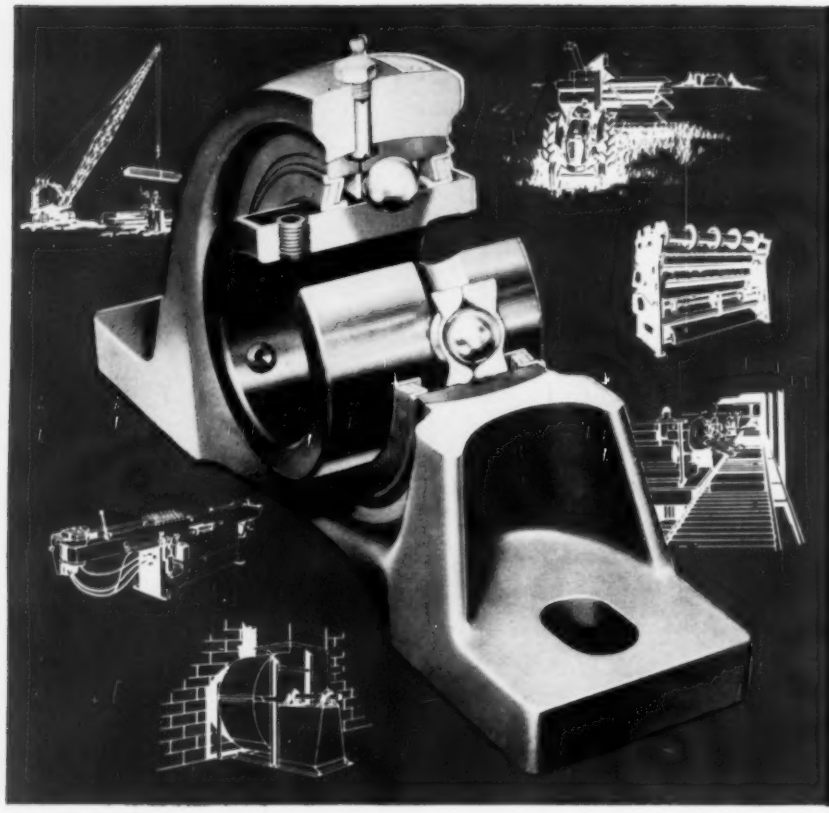

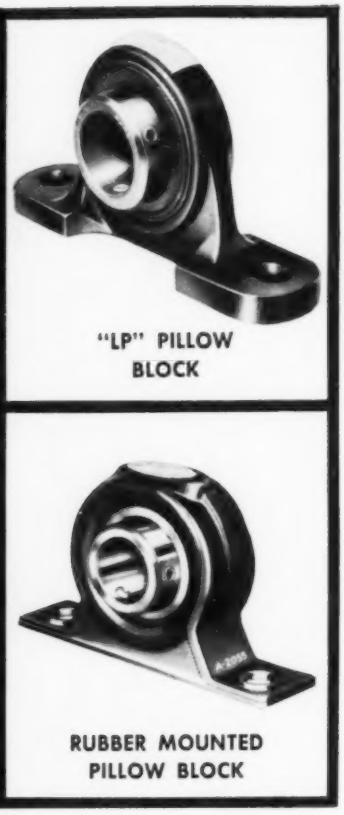

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On-the-Job Experiences Support Refrigerant Piping Design Suggestions

I HAVE READ with much interest the article, *Pressure Losses In Refrigerating Piping: What You Can Do About Them*, by W. C. Smith (October). The article as a whole is splendid. The facts presented and the advice and suggestions offered, together with the supporting evidence, should prove most valuable to the consulting engineer, the heating, piping, and air conditioning contractor, and the plant and building engineer.

Admittedly, when an engineer is called upon to design complete refrigerant piping systems, he has many factors to consider — all of which must be carefully evaluated in order that he may strike a practical and economic medium.

For example, take the case of a compressor suction line connecting the compressor and evaporator in a refrigerating plant employing fluoronated hydrocarbon refrigerants. Some of these factors are gas velocity, adequate oil return to the compressor, length of the suction line, fittings required, kind of pipe used, suction pressure carried, specific volumes, etc. — all of which have been covered by Mr. Smith.

One of the problems the author emphasized was that of oil return to the compressor. Getting the oil back from the evaporator to the compressor has long been a problem. As yet, the industry has not come up with a completely satisfactory solution.

Of course, this statement will be challenged by some who hold to the notion that "the king can do no harm." Since they are "subjects of the king," their equipment is the non-plus ultra for returning the wayward fluid to its home base, the crankcase.

As stated, the ultimate has not as yet been reached in the matter of oil return, but someday the problem will be licked and then pipe lines may be designed to carry gaseous and liquid refrigerants and not oil.

My experience and observations support Mr. Smith's recommendations concerning suction pipes and oil return. A few installations I have checked showed considerable pressure drop between the evaporators and compressors. For the most part, tests were made on installations that had been in service 10 to 12 years. In one or two instances, the pressure drop between the evaporator and compressors amounted to 1½ to 2 psig, as measured by accurate pressure gages.

It has been my practice for several years to place a test connection at the suction outlet of evaporators and a suction inlet connection at the compressor so that a test gage can be connected and pressures read at any time.

Partly plugged suction strainers and trapped oil and foreign materials — which may require several weeks or months to develop — can result in pressure loss of serious proportions even though the suction line may be correctly sized for the load it must carry.

Many persons do not believe in liquid receivers and therefore do not use them unless an installation is of fairly large capacity — just as some mechanical contractors tell their customers, "You don't need pressure gages. When you want to know about pressures, just call us and we will send a man over with gages to make a check."

Oftentimes I have found the connections between the liquid outlet of the condenser and receiver too small to permit free and rapid drainage. Where such conditions exist, liquid is bottled up in the condensers, condensing pressures are high (as are power bills), and overall performance is unsatisfactory.

Where two or more condensers are connected in parallel the liquid header should be sized to meet the maximum quantity of liquid to be handled without excess pressure drop. This same reasoning should be extended to liquid line sizing between condenser and receivers, as well as to the liquid lines between receiver and evaporators. Valuable data covering pipe sizes, etc. can be found in the standards published by the Air-Conditioning and Refrigeration Institute.

Mr. Smith has emphasized the necessity for providing against flash gas in liquid lines. This is important and generally is the result of liquid lines being too small. Flash gas in liquid lines has been directly responsible for much loss in capacity in many situations. This holds for all refrigerants in common use today. While the foregoing discussion revolves around the family of fluoronated hydrocarbon refrigerants, the same general rules apply to anhydrous ammonia and other refrigerants in common use.

Some years ago, I investigated a case of trouble in a combined ice manufacturing and cold storage plant.

"open for discussion"

continued

The problem was the result of a liquid line that supplied a 40 ton per day ice freezing tank, plus cold storage rooms. A $\frac{3}{4}$ in. liquid line was used to supply the evaporators. This line, including equivalent length for fittings (right angle elbows principally), was approximately 100 ft long. Actually, based on the maximum pounds of liquid required to flow through this line, it should have been $1\frac{1}{4}$ in.

There appears to be an antipathy among some of the "best minds" in the air conditioning industry against equipping a fluoronated hydrocarbon refrigerant liquid receiver with a gage glass to indicate the level of the liquid in the receiver. They prefer some sort of a bull's-eye indicator. Some will go so far as to say, "You don't need a liquid receiver. Let us hook the evaporator up our way and we will save you some money."

Mr. Smith is to be complimented on his excellent handling of this vital subject.

C. T. Baker
Consulting Engineer

As Yet, No One Has Proved That Odor Sources Must Be in Vaporous State

I enjoyed reading Warren Viessman's timely review on odors in air conditioned spaces, *Weigh Odor Control Methods Carefully* (September), but feel compelled to kick a couple of not-so-dead horses.

The first horse is that one which states that "to be odorous a substance must be either already in a gaseous or vaporous state, or possess a vapor pressure." Everyone seems to say this because every one else says it. Yet, no one has proved it. There is, in fact, evidence to the contrary. Atmospheres contaminated with inert dust particles, of the kind which have no demonstrable vapor pressure, are sometimes odorous. Certainly, many well-known odorous systems (atmospheres containing tobacco or other combustion smokes, for example), are complexes of vapors and particles, and it is sheer presumption to blame all the odor on the vapors. My associates and I are investigating these interesting interactions, under a U.S. Public Health Service research grant.

The second horse to be kicked is the one about "typical components" of odorous atmospheres. Pyridine and ammonia from cigarettes, for example, or hydrogen sulfite from industrial effluents, are cited. The complexity of many odorous atmospheres begins to make itself felt when you try to similate one by mixing "typical" components from the chemical shelf. The character of such mixtures is indeed a reflection of their complex makeup and bears little resemblance to one or two components which may be isolated from them.

Amos Turk
Consulting Chemist

The author's reply — Dr. Turk's comments and review of my article are appreciated. He is an outstanding authority on several facets of the subject. In fact, the book, *Air Conservation Engineering*, which he jointly authored with H. Sleik was used as background information for some of my material.

In regard to Dr. Turk's first "not-so-dead horse," the definition of odors used is the classical accepted definition presented by McCord and Witheridge in their volume, *Odors: Physiology and Control*. I realize that our basic knowledge is undergoing rapid expansion these days and that many of our concepts are changing in the light of scientific development. It is possible that Dr. Turk's research will establish new concepts in the field of odor transmission. I for one will anxiously await the result of his research. In the meantime I believe that the definition of odor, while perhaps not precisely correct, is presently adequate for the engineering fraternity concerned with odor control applications. The definition does not preclude the consideration of odor release by the volatile constituents of particulates, which is often very important.

Regarding his second "not-so-dead horse," I do not believe I used the term "typical components." I agree with Dr. Turk that some error may be introduced in using chemical compounds or typical components as synthetic odorous materials, even though they may be the principal constituents of cigarette, body, goat, or other odors. However, it is quite handy for some tests in the laboratory to use a compound for goat, skunk, or other odors, rather than use the goat or skunk itself. Better control of the odor can usually be obtained and test results can be reproduced. Variation of results from the basic body, cigarette, or other odor under study can also be determined.

Warren Viessman
Mechanical Engineering Consultant
Research Facilities
Hq, Air Research & Development Command
U.S. Air Force

Preparation of Maintenance Manuals Must Be Covered in Engineer's Fee

The position regarding operation manuals in the September HPAC Engineering Data File is well taken. Certainly, no one who has connection with any given job is in better position to prepare such a manual than the engineer who designed it.

We, as consulting engineers, would be happy to undertake such preparation in connection with our work *if* the obligation to do so were recognized during negotiations and *if* the fee were established sufficiently higher than the design fee to compensate for the added effort. We have one client for whom we have done upward of 50 jobs who has this need in common with the Armed Forces installations. The matter has often been discussed, but the client has never been willing to pay.

The maintenance manual is a horse of a different color. It is our opinion that seldom will a design engi-

neer be found who has the requisite skill and experience to prepare such a manual. We believe it should be done either by the agency supervising construction (if the design consultant were hired for supervision also, then he would *become* qualified) or by the operating personnel or agency.

P. N. Vinther
Zumwalt & Vinther
Consulting Engineers

Expansion Loop Design Technique Differs from Code Requirements

Regarding his article, *New Methods Speed Design of Pipeline Loops* (July), I would appreciate having Louis E. Partch comment on the following:

1) In Example 1, he has sized the expansion loop using one-half of the total calculated expansion (using 50 percent cold spring). According to the Code for Pressure Piping ASA B 31.1-1955, Paragraph 618-c, "no credit for cold spring is warranted with regards to stress." Paragraph 621-f states, "the total expansion range from the minimum to the maximum normal operating temperature shall be used in all calculations, whether piping is cold sprung or not." Since the formula $H^2 = (CE/S)\Delta Di$ is based on a bending stress of 1400 psi, does the use of one-half of the total expansion violate the above sections of the code?

2) In Example 2, Mr. Partch has used an allowable stress of 7800 psi. From this he subtracts pressure stress of 2600 psi and uses 5200 psi as a maximum allowable bending stress. According to the Code, Paragraph 622-c the maximum computed expansion stress is $S_a = f\ (1.25\ S_c + 0.25\ S_h)$. The allowable stress range for the material in this example would be 20,700 psi. Would Mr. Partch please explain this?

E. Yuknis
Assistant Engineer, Mechanical Design
Pioneer Service & Engineering Co.

The author's reply — The points presented by Mr. Yuknis require some study of the Code. Paragraph 618-c specifies that expansion loops shall be designed with no credit for cold spring with regard to stress. This requirement may be necessary to allow for possible neglect on the part of the erection gang to provide the design cold spring. It then necessitates the use of the total expansion, instead of 50 percent as given in the example. The result in this example is an increase of 50 percent in the dimensions of the loop.

The allowable stress range, however, is 21,000 psi. Now, if it is possible to interpret the Code to use 21,000 psi instead of 41,000, then the height of 25.67 ft is correct. In the second example of the article, the stress range S is $f\ (1.25\ S_c + 0.25\ S_h)$. The term S_c in the cold is the allowable S at 60 deg and no longitudinal stress may be deducted if it is a steam line. The term S_h, however, should be reduced by S of internal pressure or 2600 psi so that S_h should be:

$S_a = f\ [1.25\ S_c + 0.25\ (S_h - S_p)]$

"open for discussion"

continued

Then if f is unity:

$S_a = 1.25\ (15{,}000) + 0.25\ (7800 - 2600)$
$= 18{,}750 + 1300$
$= 20{,}050$ psi

Comments on this interpretation of the Code may help some of us who have not been able to follow the ideas that have contributed to the term *stress range*.

The main idea of the article was to present the formulas for rectangular loops to enable the designer to determine the dimensions directly. This is in contrast with the idea of starting with a sketch with tentative dimensions followed by analysis and, if necessary, an adjustment of dimensions and repeated analysis.

Compliance with the Code is attained by using the proper values for the amount of expansion, proper stress values and modulus of elasticity that affect the value of H.

Louis E. Partch
Mechanical Engineer

Writer's Far East Military Experience Differs from "Tobacco Housing" Job

John W. McKay's article, *Fuel Oil Piping Design Factors Found in "Tobacco Housing" Tests* (August), was very interesting from a number of aspects. The author's problems and experiences with heating in the European area appear to have been remarkably similar to mine in the Far East.

Some of these problems might not be readily apparent to engineers who have had little or no experience with the heating methods, standards, and customs of foreign countries, or with Army, Navy or Air Force design and operational requirements for housing, or the complications of using restricted funds (such as those obtained through Commodity Credit transactions).

The comments regarding workmanship emphasize the point that in overseas areas close, competent construction inspection is a most critical requirement. Poor threading on piping, dirt and refuse left to clog valves and filters, and poor sloping and looping which permit air binding will cause malfunctioning of the best designed system.

I would like to have seen the overall cost study made on the heating system and the oil distribution lines for the system Mr. McKay describes. We once had a similar problem based on 40 housing units. We found that, because each unit was in an individual building and because of the wide separation of the buildings, use of an oil distribution piping system from a central point was not economically justifiable. When oil fired furnaces where specified, individual tanks were usually specified. In a few instances, two units were served by one tank.

The necessity for a small day tank with a float control in each housing unit added to the prorated cost of

"open for discussion"

continued

the 3000 gal central tank, pump, and piping (and probably with a shutoff valve to isolate each unit) would appear to exceed the cost of providing one 300 gal tank for the two housing units in each building. A dual stage pump on each burner would have furnished the lift necessary to raise the oil from a small buried tank located outside each duplex.

The need for a return oil line would have been eliminated by installing a pressure relief valve and loop at the pump which would maintain a constant pressure on the supply line. Flow would be adjustable at the float controlled day tank to suit individual conditions.

Mr. McKay also mentioned reduction in fire hazard due to elimination of oil spillage. I am curious as to whether or not the day tank is of a completely closed type or if malfunctioning of the float control might permit overflow of the oil.

We learned that, rather than distribute oil via piping from a central tank, it was preferable to generate and distribute steam or hot water from a small automatic central plant. In addition to other advantages, this would provide a little more living area in each housing unit by eliminating the space required for the furnaces and hot water heater.

We found that each case required careful consideration of a multiplicity of factors. Sometimes the design best for a heating installation in the U.S. would not be feasible for a similar installation in an overseas area because of a lack of suitable local equipment, or because of changing military needs.

I would be interested also in learning whether or not the theoretical savings actually were realized in operation.

WILLIE HAMMER
Chief, Installations Branch
Hq, Ordnance Weapons Command
Rock Island Arsenal

THE AUTHOR'S REPLY—I certainly concur with Mr. Hammer's comments regarding the necessity for critical inspection of construction work overseas. It is very difficult for the uninitiated to understand the different outlooks and methods of work as practiced by the foreign laborer.

The overall cost study on the heating system and the oil distribution lines was prepared by the architect-engineer and is therefore unavailable at this time. However, it is agreed that a distribution system cannot be economically justified on a first cost basis. The real savings show up in the labor and tank truck costs of filling one 3000 gal tank as compared to filling ten 300 gal tanks over a 10-year period. Here, again, we have the unusual situation where the savings are realized by the Government rather than the oil company or distributor.

The suggested use of a pressure relief valve and loop at the pump to maintain a constant pressure on the supply line is a good point. However, in this particular case, by the time it was realized that a circulating pump would be necessary, the suction line had already been installed.

The day tanks were provided with a vent to the return line so that in case of a malfunctioning float valve the excess oil would be routed back to the return line instead of spilling to the ground.

A steam or hot water heating system from a small automatic central plant would provide a little more living area in each house and be much cleaner and satisfactory for the occupants, but it is also difficult to justify from a cost basis. Here, as Mr. Hammer points out, each case requires careful consideration of a number of factors.

Maintenance and operation records regarding the theoretical and actual savings are not available here in Italy. On our next trip to London we will try to secure some data on this aspect of the problem.

JOHN W. MCKAY
Mechanical Engineer
Mediterranean Div.
Corps of Engineers
U.S. Army

Recent Article Well Illustrates Present Status of the Heat Pump

I HAVE found the article, *Many Ways to Use Heat Pump Cycles,* by E. R. Ambrose (August), to contain a complete discussion of the present situation of the heat pump. It is unfortunate that there is so little general knowledge of the simplicity and feasibility of this type of system. We welcome articles of this nature.

As Mr. Ambrose points out, a careful study should be made in any case before applying a heat pump system. We would like to emphasize this. All too often, engineers and architects will take up an idea simply because it worked somewhere else — without considering that local conditions may not parallel those in other areas.

We would also like to note that solar energy is an excellent source of heat for the heat pump, although thus far it has been difficult to use in large buildings. In our solar building we have had very good success with a heat pump using solar energy as its source. See *Performance of a Solar Heated Office Building,* by F. H. Bridgers, D. D. Paxton, and myself, in the November 1957 issue.

Mr. Ambrose has previously experimented with and reported on the subject of solar energy heat pumps (although his approach was different from ours) in *The Heat Pump and Solar Energy,* which is published in the Proceedings of the World Symposium on Applied Solar Energy, 1955.

ROGER W. HAINES
Chief Engineer
Bridgers & Paxton
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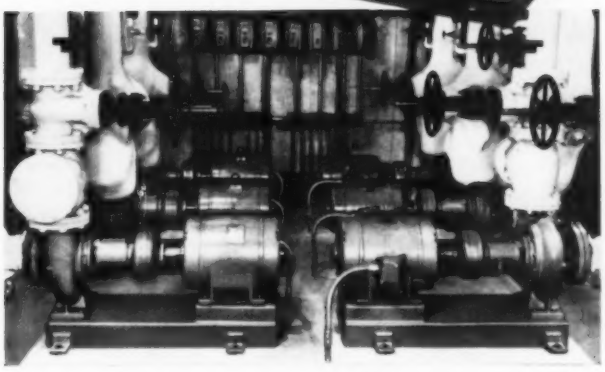

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question of the month

"How Much Heat for Dry Kilns?"

This question was asked previously in Heating, Piping & Air Conditioning and is repeated here, along with answers that have been received from readers. Other answers or comments for publication are invited.

"A plant making veneer crates for fruit has two dry kilns, each 7 × 22 × 120 ft. A total of 8000 wet crates are put through these each day and each crate contains about 8 lb of water. Banks of steam coils at one end with powerful exhaust fans at the other end furnish the present drying medium.

"The plant is shut down on Saturday, but the owners want to install auxiliary heat to make it possible to operate the kilns on that day.

"What is the amount of heat required for this application? In my effort to locate a direct fired heater, I have estimated the heating load to be from 280,000 to 6,400,000 Btu per hr, but I feel that my answer needs checking."
H.W.H.

90 to 95 Percent Recirculation Will Greatly Reduce Heat Load

H. W. H. REALLY does not give enough information to permit a truly accurate estimate of the heat requirements. Eight thousand crates per day are dried, but is this an 8, 16, or 24 hr day?

If the drying is done in eight hours it would be at the rate of 1000 crates per hr and the moisture evaporated would be at the rate of 8000 lb per hr.

The heating load in a dry kiln consists of the latent heat of vaporization, the required heat to overcome hygroscopic attraction of the wood, the heat required to bring the temperature of the material in its wet state up to kiln temperature, the heat required to raise the temperature of air in the kiln, the heat loss through walls, and the heat required to bring the temperature of the ventilating air up to kiln temperature.

From the information given it seems that all the air handled by the fans is brought in from outside and must be heated up to kiln temperature. In a well-designed and well-operated kiln, 90 to 95 percent of the air handled by the fans is recirculated. About 5 to 10 percent is vented to the outside and replaced by dry outside air. Recirculation should be given consideration by H.W.H.

In drying lumber in a modern kiln, the average steam consumption is about 3 lb of steam per pound of moisture evaporated. This is for lumber that can be dried in three to four days.

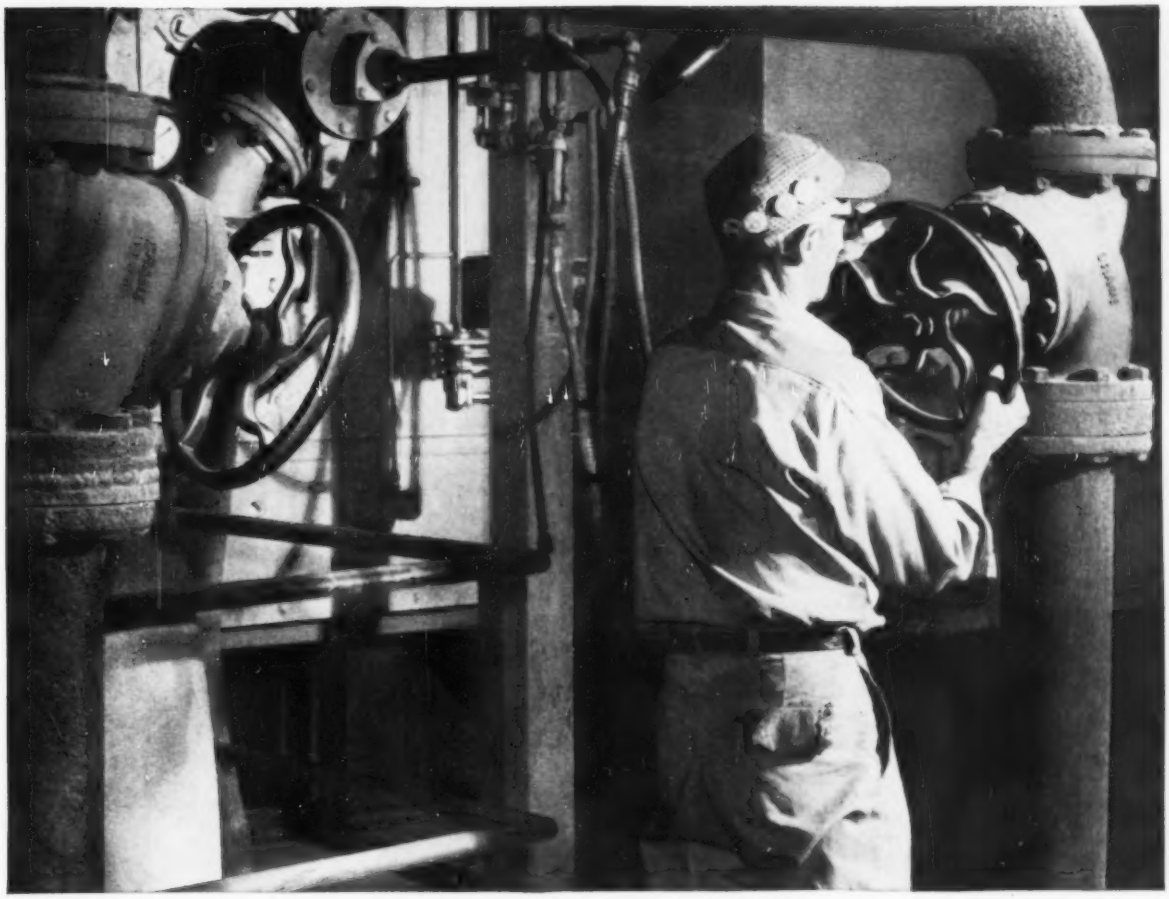
RAY H. MCGLAUFLIN
Heating, Ventilating, and Kiln Engineer

Presents Equations for Estimating Heat Required to Sastisfy Conditions

DRYING is a means of removing varying quantities of moisture from solid or semi-fluid materials. Evaporation is a method commonly employed to accomplish this. A dryer will reduce or remove surface liquid, internal moisture, and any water that is chemically combined. The surface liquid clings to the material outer surface.

Inherent moisture and bed moisture are terms frequently used for describing moisture in the material that is not on its surface. Chemically combined water is that occurring when a chemical component of the material changes its composition induced by heat or by other means.

Usual practice is to classify continuous drying problems into three categories and arrive at a balance of



Crane diaphragm valves on gas lines to boilers...8 years with no maintenance

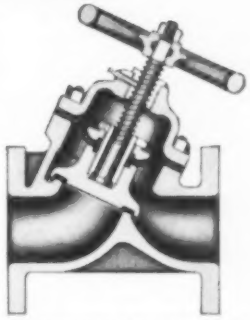
Before Union Electric Co.'s Venice Station, St. Louis, changed to Crane packless diaphragm valves, the plug valves used on natural gas fuel lines to boilers were causing costly maintenance. Records showed excessive repacking and accelerated seat wear.

Since changing to Crane valves in 1951, there has been no leakage, no seat wear, no trouble of any kind. Tight seating is assured by the resilient, neoprene disc-insert that actually absorbs hard foreign particles. The disc and diaphragm are separate members. The diaphragm functions only to seal the bonnet and is not subject to the crushing or severe flexing that can cause early rupture in ordinary diaphragm valves. The disc insures tight closure even if the diaphragm should fail. After eight years' continuous, maintenance-free service, the Crane valves still seat tight—show no sign of wear.

The same Crane features that perform so well on gas service save Union Electric many maintenance dollars on raw river water lines used for ash sluicing and on compressed air and other water lines. They can do the same for you.

Write for free booklet

Get the complete story on Crane diaphragm valves. Ask your Crane Representative for Bulletin AD-1942, or write to the address below.



Note separate disc-diaphragm construction. Diaphragm serves only as bonnet seal while disc does the seating—holds line fluid even if diaphragm should fail. Wide choice of body, trim and lining materials. Screwed or flanged ends.

CRANE® VALVES & FITTINGS

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these three classes in a practical manner. These classifications are:

1) Application of heat to the material and/or to the air mixture which carries the moisture away.

2) Means for removing the water, vapor, steam, or mixture. This requires a study of vapor pressures.

3) Conveying the material in its wet, semi-dried, and dried states into, through, and out of the apparatus — providing sufficient time for contact with the heating and moisture-removing elements.

The primary function of the heat is to elevate the temperature of the material and the water it carries to a required discharge temperature, evaporate the liquid, heat the drying equipment (including appurtenances such as trays, supports, etc.) to the proper temperature level, impart heat into the waste humid air as sensible heat above the outdoor air temperature, and replace heat lost to the surroundings by conduction through the dryer housing.

The wetness of the material is expressed numerically as the percentage of the wet weight lost when a weighted sample of the wet material is heated to a specific temperature for a specified period of time (usually a few degrees above the boiling point of water). The American Society for Testing Materials has established standard procedures for determining water contents of many materials.

Dryers are available in three general types. Direct, indirect and steam heated. The last design may use superheated, high pressure, or low pressure steam and give satisfactory performance. When the initial and all final moisture contents of the material are low, the sensible heat lost in the dried product can be appreciable. H. W. H. does not state the allowable moisture content of the crates leaving the dryer. Nor does he give the initial air temperature and relative humidity.

The dryer housing is usually constructed of several different materials, the type and thickness of the walls depending upon the temperature maintained inside the dryer and type of material being processed. For estimating heat loss from the dryer due to conduction, it is necessary to know the overall coefficient of heat transfer across the dryer shell which is a function of these properties. Since this information has not been stated by H. W. H., it is not possible to calculate the heat quantity lost by conduction.

Use of the following formulas is suggested for estimating heat required to satisfy the conditions described above.

$$H = H_m + H_w + H_e + H_g + H_s + H_c$$

where:

H = total required heat, Btu per hr
H_m = sensible heat to elevate temperature of material, Btu per hr
H_w = sensible heat to elevate temperature of water to evaporation temperature, Btu per hr
H_e = heat to evaporate water, Btu per hr
H_g = sensible heat to elevate temperature of air above inlet temperature, Btu per hr
H_s = sensible heat to elevate temperature of dryer internals, Btu per hr
H_c = sensible heat lost by conduction to surroundings, Btu per hr

or:

$$H_m = W_m C_m (T_f - T_i)$$
$$H_w = W_w C_w (T_f - T_i)$$
$$H_e = W_w LH$$
$$H_g = W_g C_g (T_f - T_i)$$
$$H_s = W_s C_s (T_f - T_i)$$
$$H_c = U A (T_f - T_a)$$

where:

W_m = rate of wood feed to dryer, lb per hr
C_m = specific heat of wood, Btu per lb per F (0.5 average value)
T_f = final temperature of air, wood, and vapor, F (212)
T_i = initial temperature of air and wood, F
W_w = rate of water carried by wood into dryer, lb per hr
C_w = specific heat of water, Btu per lb per F (1)
LH = latent heat of evaporation of water, Btu per lb (1000)
W_g = weight of incoming air, lb per hr
C_g = specific heat of air, Btu per lb per F (0.24 average value)
W_s = weight of dryer internals, lb
C_s = specific heat of dryer internals, Btu per lb per F (0.12)
U = overall thermal conductivity of dryer shell, Btu per hr per F per sq ft
A = surface area of dryer shell, sq ft
T_a = ambient air temperature surrounding shell, F

The following calculations are offered as a quick check for estimating the heat required for sensible heat gains of the air, wood, and water, and latent heat of vaporization of the water (assuming the initial temperature is 70 F).

Total crates per day	8000
Number of dryers	2
Crates per day per dryer	4000
Average crates per hr per dryer	166.6
Average water content of crates, lb	8
Average water to be removed, lb per hr	1332.8
Sensible heat gain by wood, Btu per hr 166.6 × 0.5 (212 −70) =	11,850
Sensible heat gain by water, Btu per hr 1332.8 × 1 (212 −70) =	189,500
Latent heat of vaporization, Btu per hr 1332.8 × 1000 =	1,332,800
Estimated total required sensible and latent heat per kiln,	1,554,130 Btu per hr

As stated, since details of dryer internals and wall construction have not been given by H. W. H., estimated heat requirements due to heat absorption by the internals and conduction to the surroundings cannot be made. Also, since the capacity of the fans has not been specified, the air flow rate and required sensible heat input cannot be calculated. As a very rough approximation, these combined requirements may be assumed to equal 100 percent of the above estimated sensible and latent heat requirements, giving a thermal input of approximately 3,068,260 Btu per hr per kiln.

To be assured adequate heat is available at all times, it is recommended H. W. H. consider non-uniformity of moisture content of the crates, varying feeding rates entering the dryer, and thermal losses resulting from poor mechanical conditions of the dryer. A 50 percent safety factor is suggested to compensate for these unknowns. Applying this value yields an estimated total required heat input of approximately 9,204,780 Btu per hr.

H. B. WAYNE
Consulting Engineer

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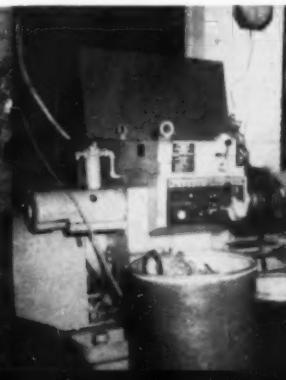

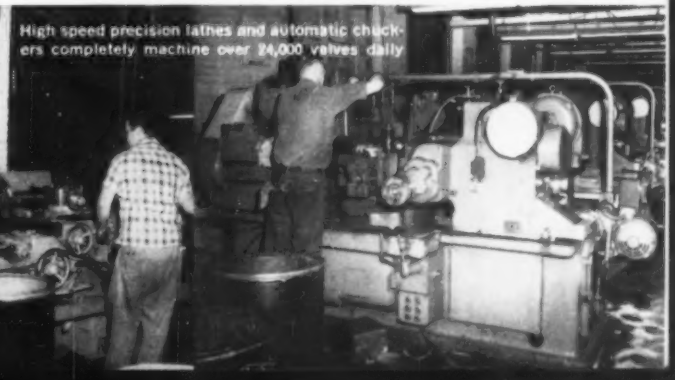

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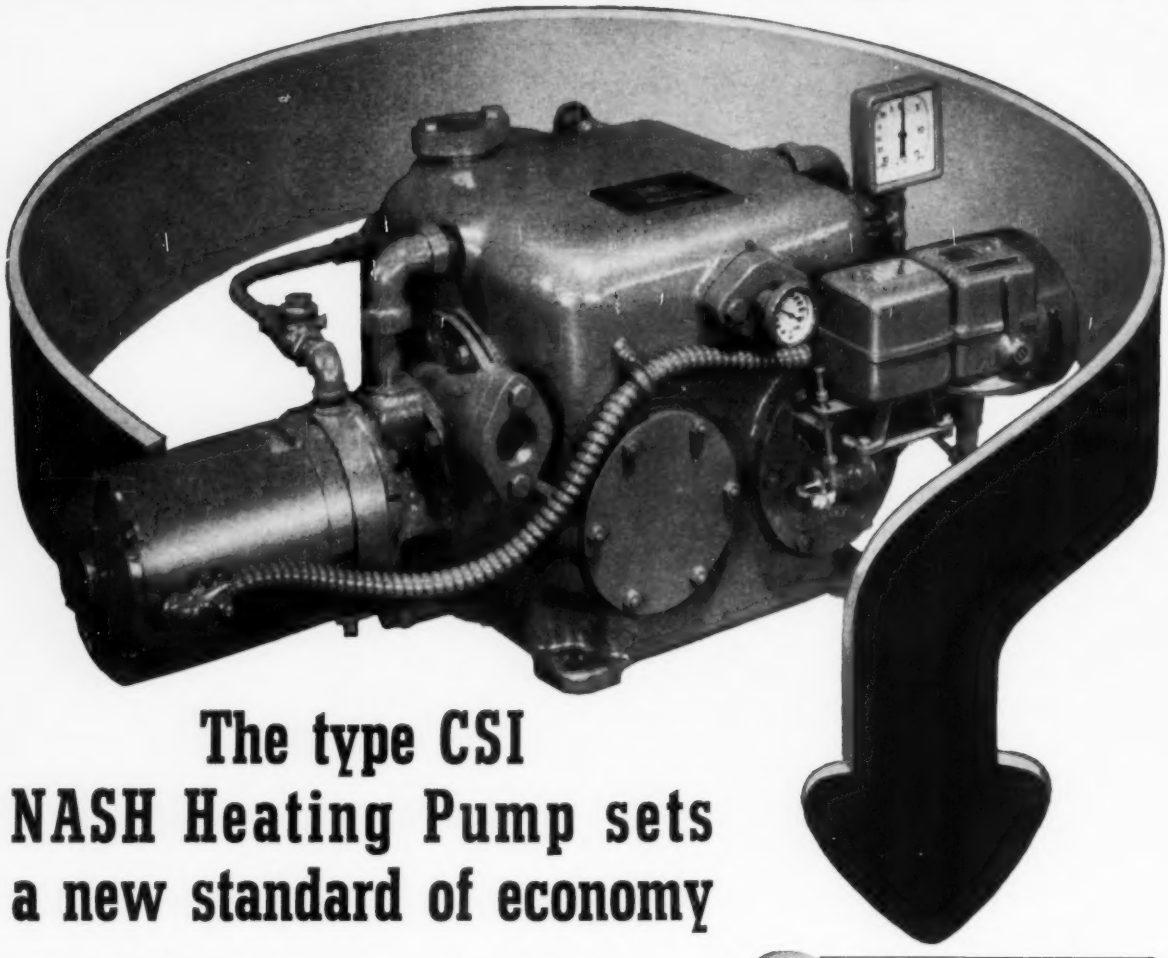

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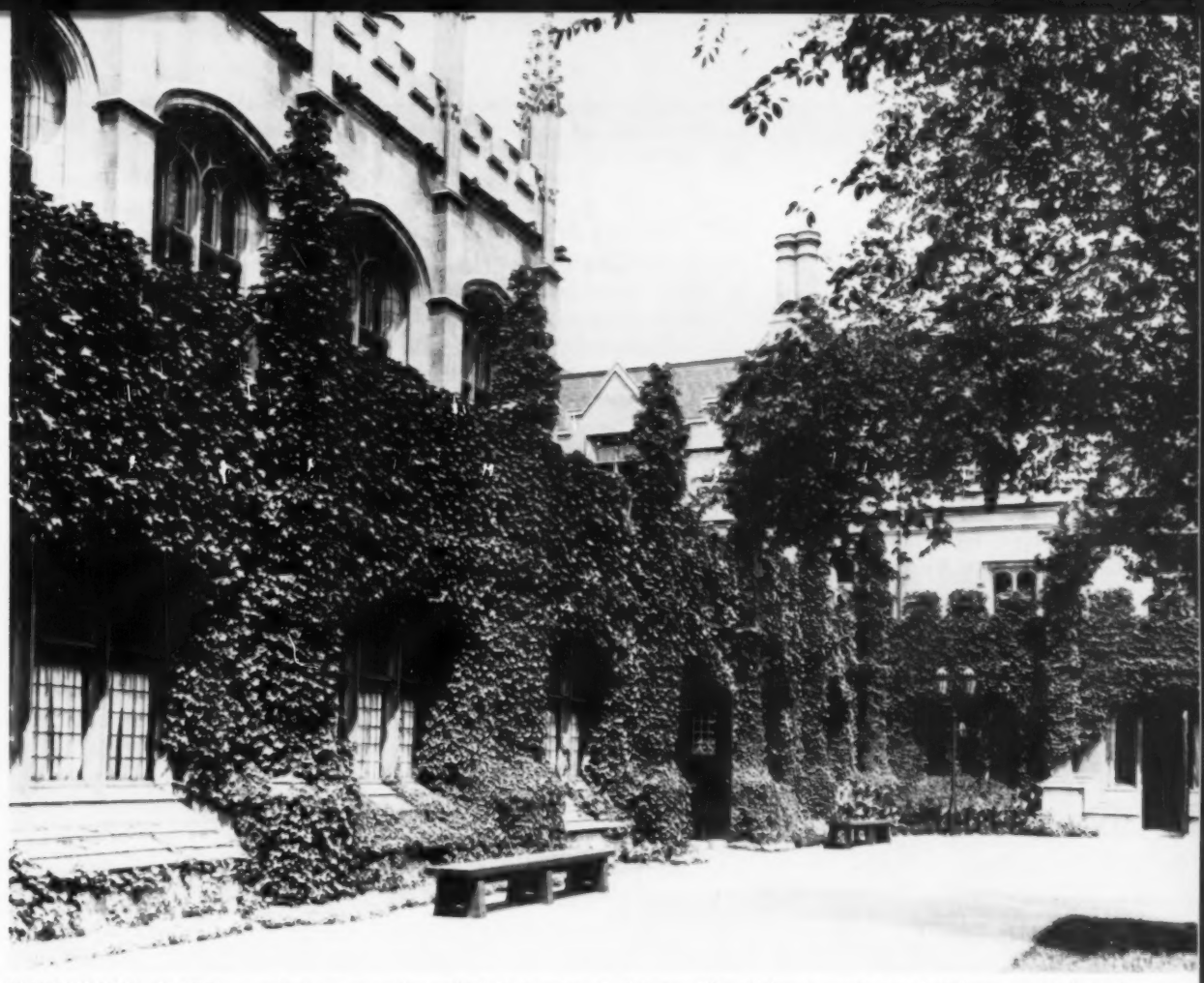


HUTCHINSON COURT, a typical scene at ivy-walled University of Chicago. The Midway's nearly 100 buildings are all heated from a central steam plant housing four boilers

A TESTIMONIAL FOR SOUND ENGINEERING:

U. of C. Central Plant Marks 30 Years Of Reliable, Low Maintenance Heating

BY LYMAN R. FLOOK
Formerly, Superintendent of Buildings and Grounds
University of Chicago

ON NOVEMBER 15, 1929 the then new central heating plant at the University of Chicago first took the steam load. Today, about a million tons of coal later, the plant's efficiency has not fallen off—in fact it has been increased, to meet the load created by added construction—and the original piping and boiler tubes remain.

This feat is a testimonial for the engineering that went into both the original installation and into the modifications that have been made in the last 30 years to keep the plant's capacity up to the needs of a growing university.

A number of these modifications of parts of the equipment warrant special interest. The university's nearly 100 buildings, built on roughly 100 acres, and the location of the plant and its underground connecting steam piping are shown in Fig. 1. The plant itself is a 90 ft cube—its floor area being about the size of a baseball diamond infield.

The four watertube boilers, served by two stacks, have both forced draft and induced draft fans and are fueled

by chaingrate stokers. Boiler design includes three top drums, one bottom drum and bent tubes. Piping and controls are arranged for independent testing of any one boiler while it is in service.

Since 90 percent of the water used is returned condensate, only 10 percent treated makeup water is necessary. Steam outgo in the morning is greater than return flow. Conversely, it is less later in the day when return flow is greater. To compensate for this 24-hr variation, a large reservoir stands by to guarantee adequate boiler feedwater.

Large open water heaters reduce the air content, and a desuperheater limits upper steam temperature, in heavy use periods, to prevent damage at the far end of the steam piping.

5000 Ton Coal Storage Area

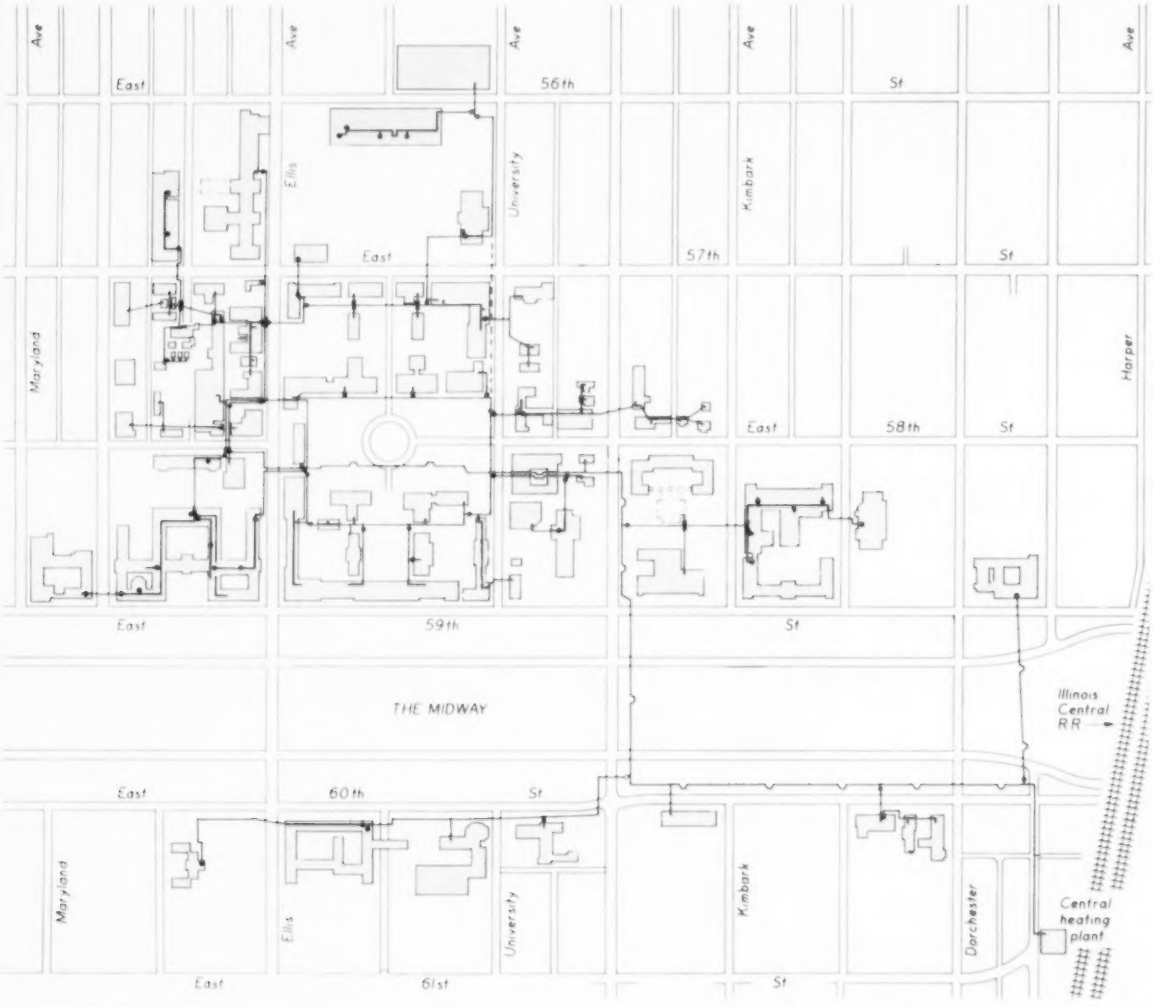
The coal used is passed through ½ in. × 3 in. screenings, delivers 12,000 Btu, and leaves 10 to 12 percent ash. Early in the life of the plant, a few dozen fuels were tested. About 20 from different mines were qualified by carload tests in boilers while in use. Thus control of cars is assured.

As of July 1, 1958, 930,016 tons of coal had been consumed to deliver 11,847 million lb of steam. Of the total coal used, about 60 percent came from Illinois mines, 30 percent from Kentucky, and the balance from Indiana.

Fig. 2 charts the expansion of the university during the past 30 years and the plant's steam output. The exciting growth in this period has required the addition of no boiler or distribution facilities. Only easily made connections have been needed.

The boilers are 1204 sq ft, at 250 percent rating, and each boiler can easily produce 77,000 lb of steam per hr. Coal handling facilities are such that four more boilers of this size can be added if future studies so indicate.

Coal is dumped from a trestle to a tunnel and carried up a cross ramp



1 UNIVERSITY OF CHICAGO is served by modest heating plant (lower right) consisting of four watertube boilers which were installed in 1929. Original plant and piping system installed in walk-through tunnels meets needs of expanded campus as result of careful scheduling and good operation and maintenance procedures

● Since it was first put into service exactly three decades ago this month, the University of Chicago's central heating system has delivered approximately 12 billion lb of steam to meet the heating, cooling, and various other needs of an expanding institution that today comprises nearly 100 buildings of various sizes and shapes. Built in 1929, after several years' judicious planning with an eye toward the future, its modest 90 ft cubical plant houses four 1200 hp coal fired watertube boilers. Steam, at 150 psig, is conveyed via underground steam mains which are run in 6600 ft of walk-through tunnels to points of use. Now, 30 years later, the system's original piping and boiler tubes are still in use—truly a testimonial for sound engineering.

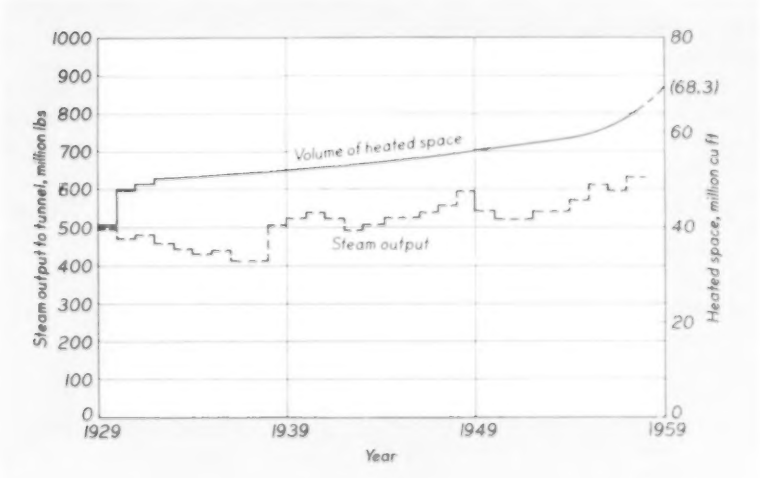
Mr. Flook, a 1913 civil engineering graduate from the University of Michigan, has had long experience in design, construction, operation, and maintenance of very large physical plants. Professional engineer, administrator, manager, lecturer, and writer, he was associated with the University of Chicago from 1919 to 1954, the year of his retirement. Since 1947, Mr. Flook has served in various special posts, most notably as construction manager for the U. S. Atomic Energy Commission's Argonne National Laboratory, near Chicago. In addition to his many professional society affiliations, he is a past president of the National Association of Physical Plant Administrators of Universities and Colleges.

to a bucket system, which in turn discharges onto a belt over the 1200-ton coal bunker. Outside washed coal storage for 5000 tons, packed in 12 in. layers eight years ago, will be used in two more years.

Although one emergency required a three-day supply of coal to be trucked in, the plant has never been without fuel. On a few occasions, additional storage has been arranged near railroad tracks not many miles from the plant. The costs of fuel and steam for the 30-yr period are shown in Fig. 3.

Until recently, coal was used exclusively. However, with the sudden availability of a limited gas supply (only three-quarters of the need at the present time), two boilers were recently modified to burn either gas or coal.

The cost to equip these two boilers was $64,000. Anticipated savings were $26,000 per year. Unfortunately, the permitted use of gas was only about 30 percent of the contract this first year. But gas supply is presumed to become unrestricted in the near future, so the expected savings may still be realized.



2 THIRTY YEARS' EXPANSION along with steam output, plotted here. No additional boiler capacity nor main distribution facilities have been required to heat increased space

Remove Air Preheaters

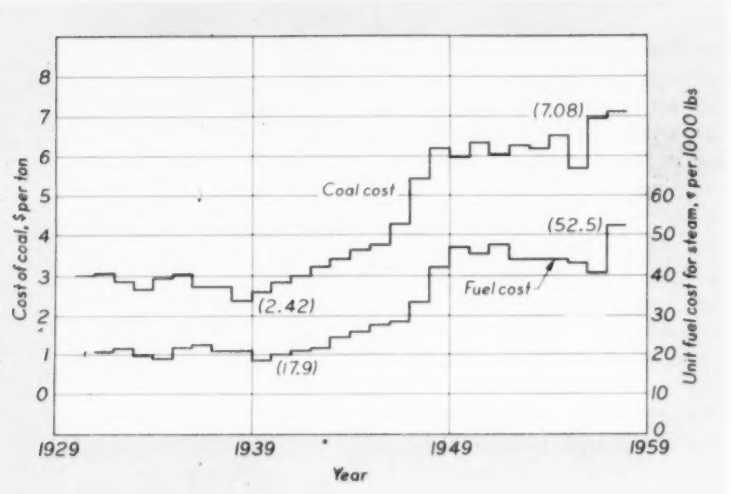
Since 1929, several equipment changes have been made. Among these, the air preheaters were taken out of service due to excessive corrosion that was being caused by the high sulfur content (1½ percent) of the flue gases used in preheating. This was done with reluctance, since an estimated 5 percent cost saving in the combustion process would be sacrificed. But this loss was outweighed by the periodic replacement of preheaters. Thus, in the long run, combustion costs are reduced materially, *without* the advantage of preheaters.

The lined steel stacks also gave trouble—chiefly from corrosion, aggravated by low gas temperatures at the tops of the stacks. Changes in the design of stacks and boiler arches resulted in smokeless combusition at full rating which prolonged life. These changes are shown in Figs. 4 and 5.

Only recently the steam turbines driving the fans have been overhauled and the fans replaced. No replacements of large pipes or fittings have been necessary. A cast steel pipe header was replaced by its manufacturer after a few years of service, at no cost to the operation. In general, building maintenance to the plant has been very low.

Tunnel System 6600 Ft Long

The underground piping consists of two 12 in. steam distribution

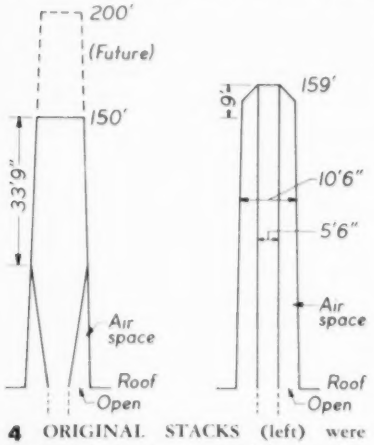


3 COMPARATIVE COSTS of fuel used to produce steam have followed this pattern over the past 30 years

mains, one 8 in. return line, and drip lines enclosed in 6600 ft of walk-through tunnels. Steam is metered at substations, where transmission at 150 psig is reduced to 75 psig at points of service.

About 80 percent of the steam produced is used for heating. The remainder is consumed by air conditioning and domestic hot water heating. A small amount is for direct use, chiefly in laboratories, sterilizing soil in greenhouses, and in thawing gutters and downspouts.

The peak load, steam output, and load duration curves for these 30 years show a reduction in unit use. The steam requirements have been held to a rate lower than an increase in heated space of buildings.



4 ORIGINAL STACKS (left) were plagued by corrison, caused by low flue gas temperatures near top. In fact, top 84 ft was replaced in 1940. Under present design (right) warm air circulates between tubes, reducing, if not eliminating, corrosion problems

Load Duration Factor Is Low

Load duration plotted in Fig. 6 measures the duration of the steam used (in percent). Plotted on the base of the chart is the *load duration factor*. It is disappointing to know that this factor is inherently low. The actual use of a heating plant in Chicago, year in and year out, is only about one-third of its rated capacity.

A minor improvement, and this has been only recently, is the use of steam in summer for space cooling. Fig. 7 shows this effect, which is growing only slowly.

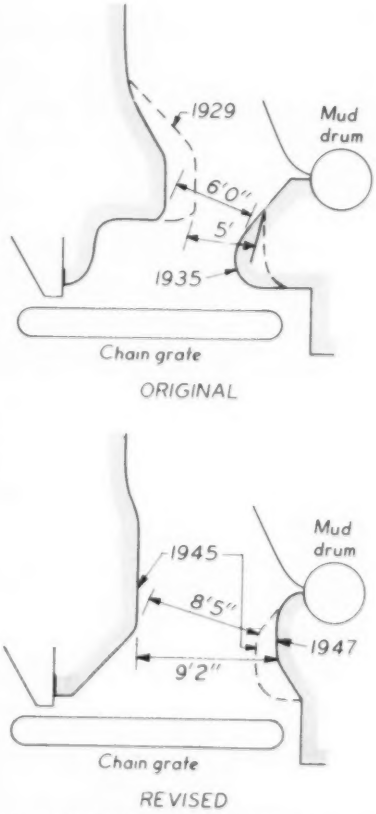
The boilers have maintained the efficiencies shown in Fig. 8. The drums, three above and one below, were increased $\frac{1}{8}$ in. in plate thickness over that required by the Code. This was done in the original design in order to assure very long life. In 30 years' service almost no corrosion has been observed.

A stock of 9 gage $3\frac{1}{2}$ in. OD boiler tubes was included in the original contract and stored on the premises. These tubes have rusted to the point that they can never be used. Only now is replacement of the front rows — perhaps five — of the original tubes being planned: two boilers in 1960 and two in 1961.

Coal conveyor belts and the malleable buckets of the coal and ash conveyor have given extraordinary service, being replaced only once. Superheaters, made with cast iron rings, only recently required excessive cleaning costs and were re-tubed, using smooth pipe.

Capacity Adequate for Future

Boiler capacity is adequate for years to come. Although the recent maximum peak load has been 190,000 lb of steam per hr, three boilers are capable of producing 231,000 lb. Previously, one boiler was always used as a spare. However, current practice for central heating recognizes the very short duration of the peak load. Since repairs can be made during eight or nine months, and since welding methods have met emergency breaks so quickly, the



5 OVER THE YEARS, changes in combustion chamber have increased volume, greatly increased heat release, almost doubled life of exposed brickwork

peaks may now use all boiler units in calculating hourly peak output. This would, in this case, become four boilers at 77,000 lb of steam per hr each, or a total of 308,000. These figures are in terms of steam delivered to the tunnel at the heating plant wall.

Thus, the current large expansion of the university has put no great extra load on the plant, either on the boilers or the piping systems.

In terms of total space, the plant heats about 63 million cu ft. With three boilers at 250 percent rating, the reserve is 7 million cu ft; with four boilers at 250 percent rating, the reserve is equal to an increase of almost 95 million cu ft of heated space.

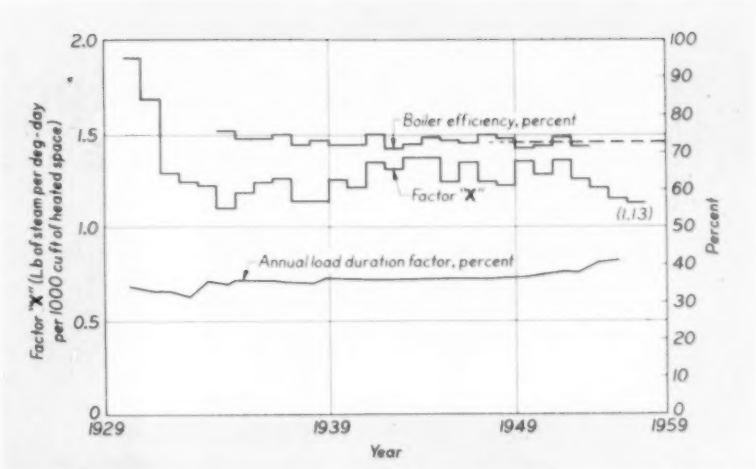
A Study in Contrast

In unhappy contrast to the 1929 plant, its worn-out predecessor, built in 1901, was extremely inefficient. Its boilers needed replacement, beginning in 1921. Large sums were spent to keep the service barely going. New construction added to the university was served by more boiler and stack capacity.

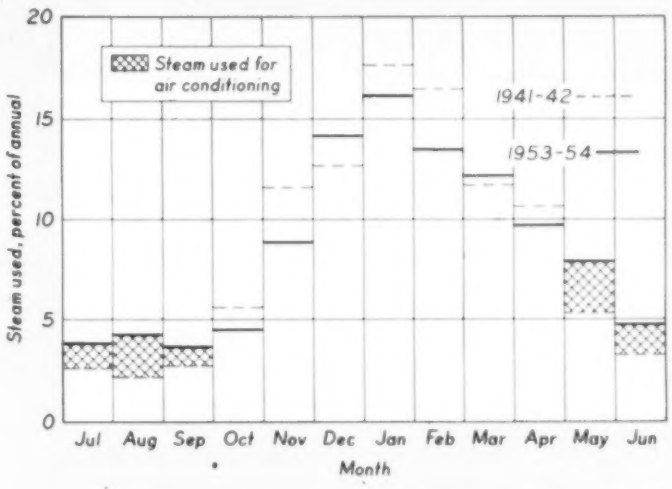
In this period the problem received considerable study. The first plan for a new plant visualized four boilers rated 500 hp each at 200 percent rating. By the time active design began, this was revised to four 1200 hp units rated 250 percent. Pressure was raised to 150 psig, and superheaters added to increase steam temperature by 150 F.

Thus, the added $50,000 per year to keep the old plant in minimum service was a blessing is disguise. It delayed the commitment of $3½ million and, importantly, provided time for study and united opinion for a plant at the railway site, amply large in capacity, with walking-size main tunnel and piping, and a resolve to buy meters to measure and allocate the service rendered, and to accumulate generous reserves for replacement.

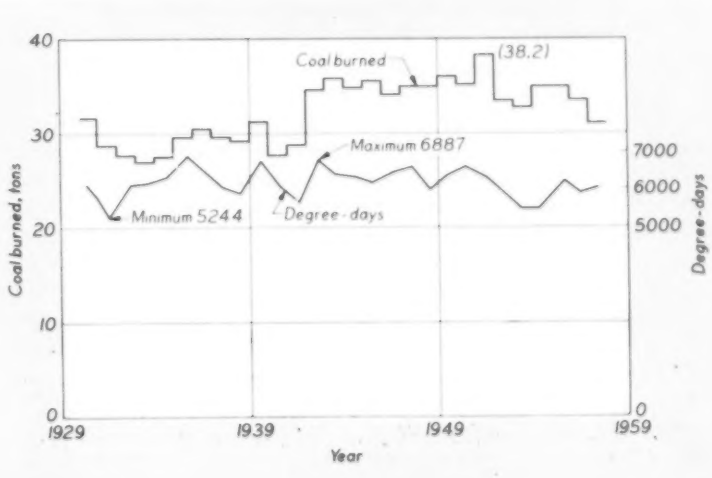
In another article, to be published in an early issue, plant operations during these 30 years will be discussed. This will include metering, water treatment, billing, and interest and depreciation. ≠



6 LOAD DURATION FACTOR indicates actual use is only one-third of plant capacity. Low Factor "X" indicates low unit steam use, good boiler efficiency



7 MONTHLY CONSUMPTION varies widely. Cooling increases summer steam use



8 COAL BURNED (top curve, in thousands of tons) has not increased in last 30 years

Piping Is Vital Lifeline in New Blood

PRODUCTION SUPERVISOR F. C. Bloom wheels out a number of stainless steel chests containing placentas from —4 F storage room in preparation for fractionation process

LIQUID OBTAINED from large centrifuge is collected in large stainless steel cans

"In essence, a new life may

BY ANTON KRAPEK
Vice President
E. Roger Hewitt Associates, Inc.
Professional Engineers

● Conveying the very fluid that keeps us alive, process piping makes up the arteries and veins that connect four 700 gal reaction tanks and eight centrifuges—the nucleus of the Michigan Department of Health's new blood fractionation laboratory. Here, fresh and outdated blood from various sources is processed to produce valuable life-giving serums. How the process takes place and how the mechanical systems were designed to meet the unique needs of the laboratory are told here.

Anton Krapek, born in Czechoslovakia, is a naturalized U. S. citizen and attended Alma (Mich.) College and is a graduate of Aeronautical University. He is a registered professional engineer in Michigan and Indiana and a member of several engineering societies and associations.

THROUGH the operations conducted in the new blood fractionation laboratory at the Michigan Department of Health, Lansing, the people of the State of Michigan are being provided with such life-giving products as serum albumin, gamma globulin, fibrinogen, and antihemophilic globulin.

Fibrinogen is produced by processing outdated blood supplied by hospitals. Antihemophilic globulin comes from fresh whole blood obtained from American Red Cross regional blood centers. Some 30,000 pints will be processed in a year's time.

The raw material used in obtaining these products is the placenta, commonly called afterbirth because it is expelled from the mother's body. Rich in blood, the placenta is the

Fractionation Lab

LABORATORY STAFF MEMBER is descending into a reaction tank in preparation for cleaning. Vertical piping furnishes air or produces vacuum for proper process control

PLACENTAL SERUM is drawn up into one of the 700 gal reaction tanks. Chilled ethylene glycol circulates through piping behind tank

indirectly be saving an old."

mother's lifeline to the unborn child. Once discarded as useless, it is a major source of blood from which these life-saving serums are made. In essence, a new life may indirectly be saving an old.

The nucleus of the new laboratory is four 700 gal suspended reaction tanks and eight centrifuges connected by glycol piping consisting of Type L hard drawn copper tube.

How Fractionation Takes Place

Placentas must be quick-frozen immediately after delivery and shipped frozen to prevent spoilage. After they are received at the laboratory, they are stored in their original stainless steel containers at −4 F. After a number has been accumulated, they are thawed, examined, and then chopped and placed in a salt water mixture. This mixture causes blood proteins to go into solution and increases the amount of proteins that can be produced by fractionation.

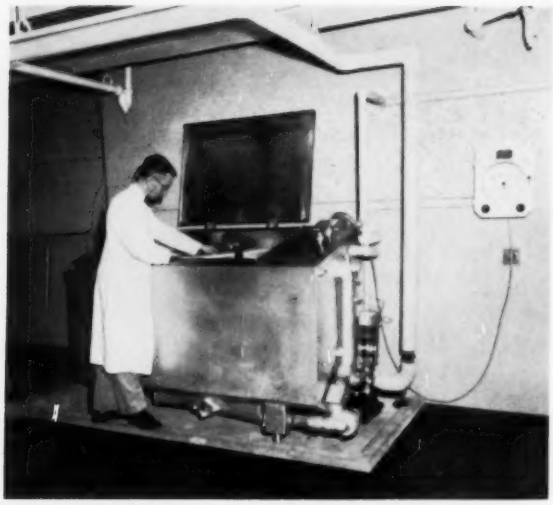
Placental solid material is then removed by straining once and then separating twice in a large centrifuge. Solids separated in these steps are discarded and the liquid, which now contains all the desired blood proteins, is stored in large stainless steel cans for further processing. The remaining liquid, known as placental serum, is then scheduled into the fractionation processes.

Calculations are made on the basis of volume as determined by weight. Scales automatically record the weight and lot number of each batch. After weighing, the liquid is drawn up into one of the 700 gal stainless steel reaction tanks. Tank capacity is equivalent to roughly 2000 pints of blood.

Each tank is suspended from the floor above; i.e., part of each is accessible from the floor above and part from below. Each tank has an explosionproof light, an access manhole and a double-bladed two-speed agitator which keeps the solution well mixed during processing. In addition, each tank has a shell cooled jacket to provide chilled temperatures under controlled conditions. The upper and lower processing rooms are maintained at 23 F.

In the tanks, fractions are made to precipitate out of solution by varying liquid temperature, acidity, alcohol concentration, salt concentration, and protein concentration. Liquid from the reaction tank is then run into one or more of the six high-speed (18,000 rpm) centrifuges. Each centrifuge is equipped with a shell type cooling coil and a revolving stainless steel cylinder approximately 4 in. in diameter and about 36 in. long.

During a centrifuge run, liquid is separated and the remaining material —protein paste— is removed from the cylinder. This paste is then resuspended and, depending upon which fraction is desired, recycled through the tanks and centrifuges as many as eight times. Protein paste



SERUM ALBUMIN is pasteurized in this unit to kill virus that causes serum jaundice. Note steam piping, control valve, recorder

OPERATING, SPACE TEMPERATURES are recorded in this nerve center. Low temperatures must be closely controlled, lest products spoil

from several final runs is accumulated in smaller mixing kettles, resuspended in a water and ice mixture, and placed into drying cylinders approximately 10 in. in diameter by 30 in. long.

After loading the cylinders into a shell freezer, they are mechanically rotated at —40 F. Rotation causes the paste to freeze in a hollow shell along the inner walls of the cylinder in preparation for drying. A rack of cylinders is connected to a high vacuum steam ejector manifold which reduces the pressure within the cylinders to 1/5000th of atmospheric pressure (150 microns) at sea level.

Low temperature, in combination with low pressure, causes the frozen water to sublime, i.e., to change from solid to gas without going through the intermediate liquid state. The dry solid remaining in the cylinder is blood protein (albumin). At this point the albumin is prepared for final solution.

Process 125,000 Placentas

By repeating the steps described, with variations of additives, cycles, etc., gamma globulin is obtained. Present schedules permit the processing of 125,000 placentas annually, the yield of which is equivalent to the yield obtained from the processing of 30,000 pints of whole blood.

In addition to this, the laboratory will also process 30,000 pints of outdated whole blood. At the present time, fibrinogen and antihemophilic globulin are derived from whole blood fractionation. Gamma globulin and albumin are produced from both sources of human blood. Before being shipped, all blood derivatives are sterilized by being filtered through cellulose-asbestos filters that remove micro-organisms. Serum albumin is pasteurized to kill the virus that causes serum jaundice; antihemophilic globulin and fibrinogen are irradiated with ultra-violet light to kill this same virus.

Further research is now under way into the possibilities of producing fibrinolysin, possibly useful in the treatment of infected wounds, abscesses, and blood clots; ceruloplasmin, which may combat Wilson's disease and may treat mental illness; and transferrin, which may be important in the treatment of anemias, virus diseases, and even cancer.

Maintain Desired Conditions

As can be seen, many diversified pieces of mechanical equipment necessarily had to be employed in order to produce the desired conditions for these operations. The upper and lower processing rooms are maintained at the desired temperature by the use of ceiling suspended unit coolers. Each floor has three such units and cooling is produced by a water cooled reciprocating compressor-condenser unit located in a room adjacent to the first floor processing room.

These processing rooms, as previously stated, are below freezing and, since alcohol is used in fractionation, they are also explosionproof. Consequently, unit coolers are provided with hot gas defrost cycles with the resultant water running through insulated piping to drains located in warm rooms within close proximity to the cold.

Next to the first floor processing room are located the 32 F extracting room and —4 F storage room. In the former, the large basket centrifuge is housed, along with two high speed centrifuges. The latter room is used for storage of placentas. The hot gas cycle is again used in both these areas; however, water from the 32 F units discharges to drains within the room. Each area has three unit coolers and each area has its own compressor. Also contained in the second floor process room is a large alcohol storage tank which is vertically floor mounted and has a shell cooling jacket.

All four reaction tank shells are served by a large capacity circulating liquid chilling unit. The alcohol tank

and high speed centrifuges are served by two smaller units. Each assembly (reaction tanks and chiller, alcohol tank and chiller, centrifuges and chiller) was designed to operate independently. However, through a series of interconnecting piping, chilling units may serve other equipment on a standby basis. Liquid chillers are fully self-contained, having liquid storage chambers, circulating pumps, and water cooled compressor-condenser units. The liquid presently used as a cooling agent is a 50 percent solution of ethylene glycol. Type L hard drawn copper tube is used for this piping. Sweat end wrought copper fittings are used with silver solder. Process water is supplied by steam operated distilling units located in a penthouse on the roof of the building. Both first-stage distillation cooling and second-stage (double-distilled) cooling are done through a cooling tower and pump. Annealed and pickled stainless steel pipe with stainless steel fittings are used for the pasteurization process. The single-stage centrifugal pump is made of Type 304 stainless steel and is used for recirculation of the solution (diluted with distilled water) in this particular process. Its totally enclosed motor is designed for continuous duty. The pasteurizer is fully self-contained.

Unit cooler compressors, liquid chiller compressors, office space cooling compressors, shell freezer compressors, etc., are served by their own cooling tower, with each compressor-condenser unit having its own water regulating valve. Here again this tower is interconnected with the distilled water tower to permit standby operation if needed. All processing spaces are controlled by remote bulb thermostats, with temperatures being constantly and remotely recorded in the building nerve center. Here, too, the automatically controlled tanks and centrifuges record their respective temperatures. These recording devices are under constant surveillance by trained laboratory personnel. Space temperatures are not permitted to vary more than two degrees except for the short duration required by the hot gas defrost cycle. A prolonged period of uncontrolled temperature could easily ruin a batch of liquid which had taken weeks to produce.

Each process room is served by a gravity flow process alcohol piping system made of Type 304 or 316 stainless steel. Screwed pattern, banded type stainless steel fittings are used. A special iron body, neoprene lined, packless diaphragm valve is used for alcohol shutoff on the gravity piping from the alcohol storage tank. Special brackets were built to support this valve, as it is relatively large in comparison with the connecting piping.

Remotely placed hose reels supply domestic hot and cold water, and hot and cold distilled water. Tin-lined Type L hard drawn copper tube with sweat-end tin-lined wrought copper fittings are used for distilled water. All joints were made with tin-weld paste solder, and leaks will be repaired with leadfree wire solder. Valves were pre-tinned by the owner and then turned over to the mechanical contractor for installation. Distilled water is used to clean the reaction tanks at least once a day.

Rooms Must be Explosionproof

One of the most intriguing problems encountered in the design of this project was the prerequisite that all equipment necessarily had to be explosionproof in the cold rooms. This, of course, was due to the extended use of alcohol in the various processes. All equipment was selected, and manufacturers were then asked if they could furnish such equipment. Space thermostats of the particular type and range required were not available for installation in explosionproof areas. As a result, remote bulb type units were used with the thermostats mounted in adjacent nonhazard areas.

Another problem was that unit coolers had to be installed with filters ahead of their coils and fans. This was dictated by the fact that the processes liberated minute particles of material into the air at certain times. These particles, in passing over the coils, would adhere to the finned surfaces. From past experience it has been extremely difficult to remove this accumulation because of its gummy consistency. After the unit cooler manufacturer was contacted, it was learned that he could not guarantee satisfactory unit performance with filters.

The consulting engineers approached the Department of Health with a plan whereby they would design filter adapters for these units, provided responsibilities for proper operation would be mutual. This was agreed upon and the special design was next considered. Adapter boxes were designed to cover the entire rear of the units to reduce air velocities to such a point that the pressure drop through the filters is practically negligible. Also, there is no apparent added load on the propeller fan motor because the buildup of material on the coil fins has been eliminated. Glass fiber filters 1 in. thick are used. Today, the coolers are performing satisfactorily, no difficulties having been encountered.

Laboratories Also Conditioned

Air conditioning for the various offices and the research laboratories is provided by two direct expansion fan-coil units. Heat is supplied by steam convectors and unit heaters. Steam is delivered through service tunnels from a central plant, as are air and gas. Vacuum is produced by a small single stage steam ejector much like the unit used for protein paste drying.

The author wishes to acknowledge the technical advice and assistance provided in the preparation of this article by Dr. G. D. Cummings, associate commissioner and director, Div. of Laboratory Services; Dr. H. D. Anderson, chief, Biologic Products Section; and Dr. Keith B. McCall, chief, Blood Derivatives Unit, Michigan Dept. of Health.

Architects for the project were Lee Black and Kenneth C. Black. E. Roger Hewitt Associates, Inc. were the consulting engineers. The mechanical (heating, piping, and air conditioning) contractor was Lorne Plumbing and Heating Co. ∓

SHEET METAL DUCTWORK can now be installed with saving in time through proper use of new duct manual

A Giant Step toward Standardization: SMACNA's Sheet Metal Duct Manual

New tool for engineers, contractors will lift veil of confusion, misunderstanding

BY JAMES H. STIGGLEMAN
Chief Mechanical Engineer
Childs & Smith
Architects and Engineers

ONE OF THE most ambitious efforts yet undertaken in the building trades is publication by the Sheet Metal and Air Conditioning Contractors National Association of its new *Duct Manual and Sheet Metal Construction for Ventilating and Air Conditioning Systems.*

This contribution, the result of compilation of extensive data by SMACNA, may at long last bring an end to the confusion and misunderstanding that exists among consulting engineers, mechanical contractors, and architects.

As a tool for the design and installation of sheet metal ducts, the manual should be invaluable to engineer and contractor alike. SMACNA is to be congratulated for this conscientious attempt to set a standard for the industry.

Saves Design Time

Generally speaking, the design of an air conditioning or ventilating system by an engineer should concern itself with proper fan, coil, and filter selection and application. Ducts should be sized for correct velocities and air volumes for distributing air throughout a structure to comply with the load conditions. These problems vary with every design. Time is required to solve them.

The standards, as presented in this new duct manual, provide the engineer with a facility for saving him time, thus allowing him to devote more of his engineering talents where they belong—in the actual design of the system. He is now assured, by proper application of this manual, of having ducts installed that will properly carry out his design.

Table 1—Recommended Sheet Metal Gauges for Rectangular Duct Construction

RECOMMENDED METAL GAUGES				Note—See Plate No. 5 for Details at Duct Connections	See Plate No.
Steel—U.S. Standard Gauge	Aluminum B & S Gauge	Copper Cold Rolled	Duct Dimension In Inches		
26	24 (.020)	16 oz.	up thru 12	Drive Slip (A), Plain "S" Slip (B), or 1" Pocket Lock (K)	6
24	22 (.025)	24 oz.	13 thru 18	Drive Slip (A), Plain "S" Slip (B), or 1" Pocket Lock (K)	6
			19 thru 30	Hemmed "S" Slip (C), 1" Bar Slip (E), or 1" Pocket Lock (K) on 4'0" centers	7
				Hemmed "S" Slip (C), 1" Bar Slip (E), or 1" Pocket Lock (K) on 8'0" centers with 1"x1"x1/8" angles on center line between	7
				Hemmed "S" Slip (C), 1" Bar Slip (E), or 1" Pocket Lock (K) on 8'0" centers with Cross Break	7A
				1" Standing Seam (I) on 5'0" centers	14
22	20 (.032)	32 oz.	31 thru 42	1" Bar Slip (E), Reinforced Bar Slip (G), or Pocket Lock (K) on 4'0" centers	8
				1" Bar Slip (E), Reinforced Bar Slip (G), or Pocket Lock (K) on 8'0" centers with 1"x1"x1/8" angles on center line between	8
				1" Standing Seam (I) on 4'0" centers	14
				Inside Longitudinal Standing Seams (I) with 1"x1"x1/8" angles on 4'0" center on exterior	13
			43 thru 54	1½" Bar Slip (E), Reinforced Bar Slip (G), or Pocket Lock (K) on 4'0" centers	9
				1½" Bar Slip (E), Reinforced Bar Slip (G), or Pocket Lock (K) on 8'0" centers with 1½"x1½"x1/8" angles on center line between	9
				1½" Bar Slip (E), Reinforced Bar Slip (G), or Pocket Lock (K) on 4'0" centers with Cross Break	9A
				1½" Standing Seam (I) on 3'0" centers	14
20	18 (.040)	36 oz.	55 thru 60	Inside Longitudinal Standing Seam (I) with 1½"x1½"x1/8" angles on 4'0" centers on exterior	13
			61 thru 84	Reinforced Bar Slip, (G), Angle Slip (H), Alternate Bar Slip (F), or Angle Reinforced Pocket Lock (L) on 4'0" centers using 1½"x1½"x1/8" reinforcing angles and with 1½"x1½"x1/8" angles on center line between	10
				Reinforced Bar Slip (G), Angle Slip (H), Alternate Bar Slip (F), or Angle Reinforced Pocket Lock (L) on 8'0" centers using 1½"x1½"x1/8" reinforcing angles and with 1½"x1½"x1/8" angles 2'0" on centers in between	10
				1½" Angle Reinforced Standing Seam (J) on 2'0" centers using 1½"x1½"x1/8" reinforcing Angles	14
				Inside Longitudinal Standing Seams (I) with 1½"x1½"x1/8" angles on 2'0" centers on exterior	13
18	16 (.051)	48 oz.	85 thru 96	Companion Angles (M), Angle Slip (H) or Angle Reinforced Pocket Lock (L) using 1½"x1½"x3/16" companion or reinforcing angles on 4'0" centers with 1½"x1½"x3/16" angles on center line between	11
				Companion Angles (M), Angle Slip (H) or Angle Reinforced Pocket Lock (L) using 1½"x1½"x3/16" companion or reinforcing angles on 8'0" centers with 1½"x1½"x3/16" angles on 2'0" centers in between	11
				1½" Angle Reinforced Standing Seam (J) on 2'0" centers using 1½"x1½"x3/16" reinforcing angles	14
				Inside Longitudinal Standing Seams (I) with 1½"x1½"x3/16" angles on 2'0" centers on exterior	13
			Over 96	Companion Angles (M), Angle Slip (H) or Angle Reinforced Pocket Lock (L) using 2"x2"x1/4" companion or reinforcing angles on 4'0" centers with 2"x2"x1/4" angles on center line between	12
				Companion Angles (M), Angle Slip (H) or Angle Reinforced Pocket Lock (L) using 2"x2"x1/4" companion or reinforcing angles on 8'0" centers with 2"x2"x1/4" angles 2'0" on center line between	12
				1½" Angle Reinforced Standing Seam (J) on 2'0" centers using 2"x2"x1/4" reinforcing angles	14
				Inside Longitudinal Standing Seams (I) with 2"x2"x1/4" angles on 2'0" centers on exterior	13
16			All Sizes	Kitchen exhaust ducts when grease is present in the air to be exhausted	

Above construction is recommended for low pressure systems where velocities do not exceed 1800 f.p.m. or where static pressures are not over 2 inches water gauge

No Frills, Extras

One important consideration in the manual is the fact that there are no elaborate details which might lead to rather costly construction. Great care was exercised in the selection of the illustrations and examples so that they might be strictly practical working details of sheet metal construction—including no frills nor extras which might be considered "gold plating." The manual should be scrutinized carefully by anyone who might be skeptical concerning the motives behind the manual, for they are entirely unprejudiced and a tribute to the association.

The content of the manual is as follows: an index for ready reference to each illustration; a fan designation section; a standard symbol sheet; a recommended duct construction section, including 10 illustrations; a section with 44 drawings covering fabrication of special sheet metal connections and shapes; and a suggested specification to be used in conjunction with the manual.

Specifies Sheet Metal Gages

This first article will concern itself with duct construction and plates 5 through 14. Table 1 of the manual, reproduced on the preceding page, is a complete specification of sheet metal gages for all sizes of rectangular ducts for use in ventilating systems where velocities do not exceed 1800 fpm or where static pressures are not over 2 in. water gage.

Table 1 is always used in conjunction with plate 5, which illustrates all acceptable methods of duct connections and is extremely valuable in that the terminology used can now be standard throughout the industry.

Plates 6 through 14 cover construction of all duct sizes listed in Table 1, as indicated in the right-hand column. In plates 7A and 9A the designer is given an alternate selection of cross breaking if he prefers. It should be noted that stiffening methods vary considerably where cross breaking is and is not used. There have been times when a cross break specification is waived that it is not compensated for by additional stiffening. This has led to rather unfortunate results. This is impossible with proper use of the manual.

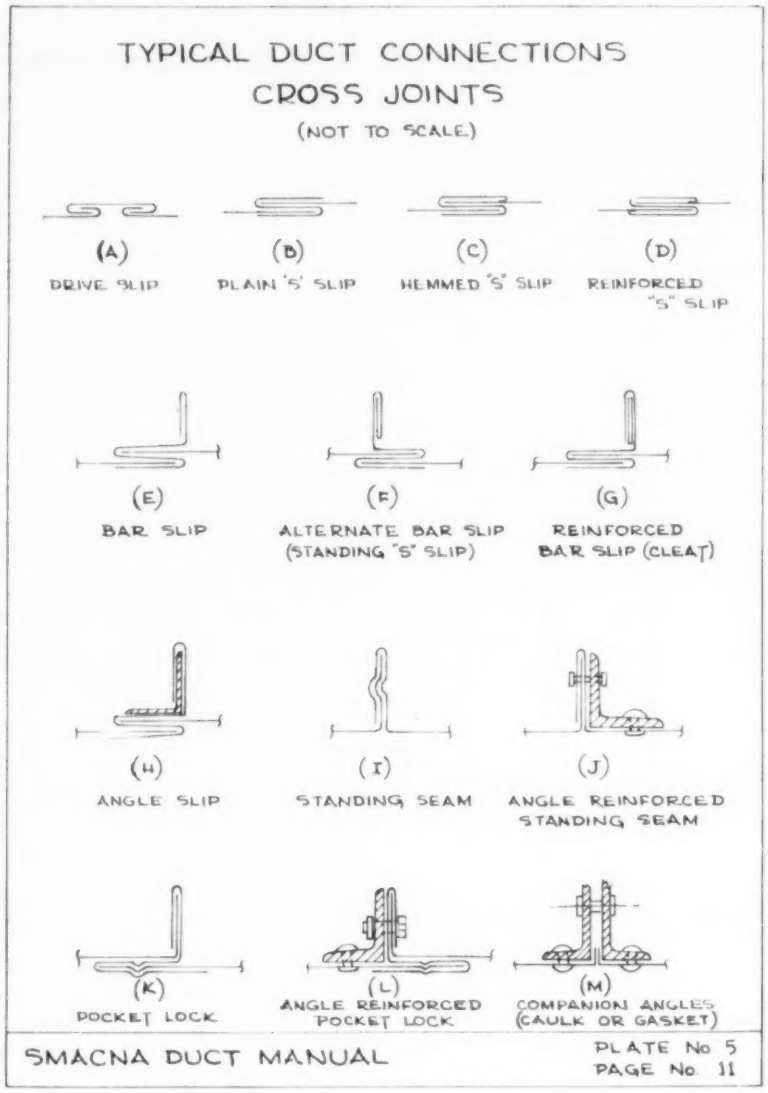


Plate 13 shows an alternate for using standing longitudinal seams inside instead of Pittsburgh locks. Plate 14 illustrates an alternate construction for using transverse standing seams.

Wide Choice of Construction

It can be seen that the engineer is offered quite a latitude in selecting the type of duct construction. The illustrations are clear and, when used with Plate 5 and Table 1, there should be nothing left to the imagination.

To clarify the preceding explanation, Plate 10 of the manual is also illustrated. This shows construction for duct sizes 61 in. through 84 in. It permits the contractor to use either 8 ft or 4 ft sheets. The legend indicates all connections shown in Plate 5, making it unnecessary to refer back and forth through the manual.

Steel and aluminum gages for this size range are also included for the same reason. Each plate is accompanied by a complete explanation on its facing page, thus further reducing the possibility of misunderstanding.

Future articles, to be published in early issues, will explain more about the manual.

PLATE NO. 5 - TYPICAL DUCT CONNECTIONS - END JOINTS

Fig. A – *DRIVE SLIP* – Ends of ducts inserted under cleat. For narrow sides of ducts that are 18" or less.

Fig. B – *PLAIN "S" SLIP* – Ends of ducts inserted into open ends of *"S"*. Use on wide sides of small ducts. (Use Drive Slip (A) on narrow sides.)

Fig. C – *HEMMED "S" SLIP* – Similar to Plain "S" Slip (B) except with one edge hemmed to produce stiffness.

Fig. D – *REINFORCED "S" SLIP* – Similar to Hemmed "S" Slip (C) except with both edges hemmed for additional stiffening.

Fig. E – *BAR SLIP* – Similar to Plain *"S"* Slip (B) except for standing edge which is formed to provide reinforcing

Fig. F – *ALTERNATE BAR SLIP (STANDING "S" SLIP)* – Same as Bar Slip (D) except standing leg is folded to three thicknesses for stiffness.

Fig. G – *REINFORCED BAR SLIP* – Similar to Bar Slip (E) except for the addition of a steel reinforcing bar inserted in the standing edge.

Fig. H – *ANGLE SLIP* – Same as Reinforced Bar Slip (F) except for the use of a reinforcing angle in place of the reinforcing bar.

Fig. I – *STANDING SEAM* – Ends of adjoining ducts are joined as shown with button punch added after assembly.

Fig. J – *ANGLE REINFORCED STANDING SEAM* – Same as Standing Seam (H) except for reinforcement with angle, one leg of which is fastened to the duct and the other leg is secured to the standing edge of the seam.

Fig. K – *POCKET LOCK* – Normally used on all four sides of a duct. The pocket section is button punched to the duct; the other end is flanged outward to join with second sheet and then hammered down.

Fig. L – *ANGLE REINFORCED POCKET LOCK* – Same as Pocket Lock (K) with added angle stiffener.

Fig. M – *COMPANION ANGLES* – Angle frames are riveted, bolted or welded to duct ends and are then bolted together with gasket or caulking to prevent air leakage. Recommended for use where duct sections must be removed periodically.

Some of the above connections may be favored over others in certain parts of the country, and all of them are not listed in Table I. Substitutions can be made for those that are listed provided the alternate selection is comparable and provided the same quality of construction is maintained.

PLATE NO. 10 - DUCTS 61 in. THRU 84 in.

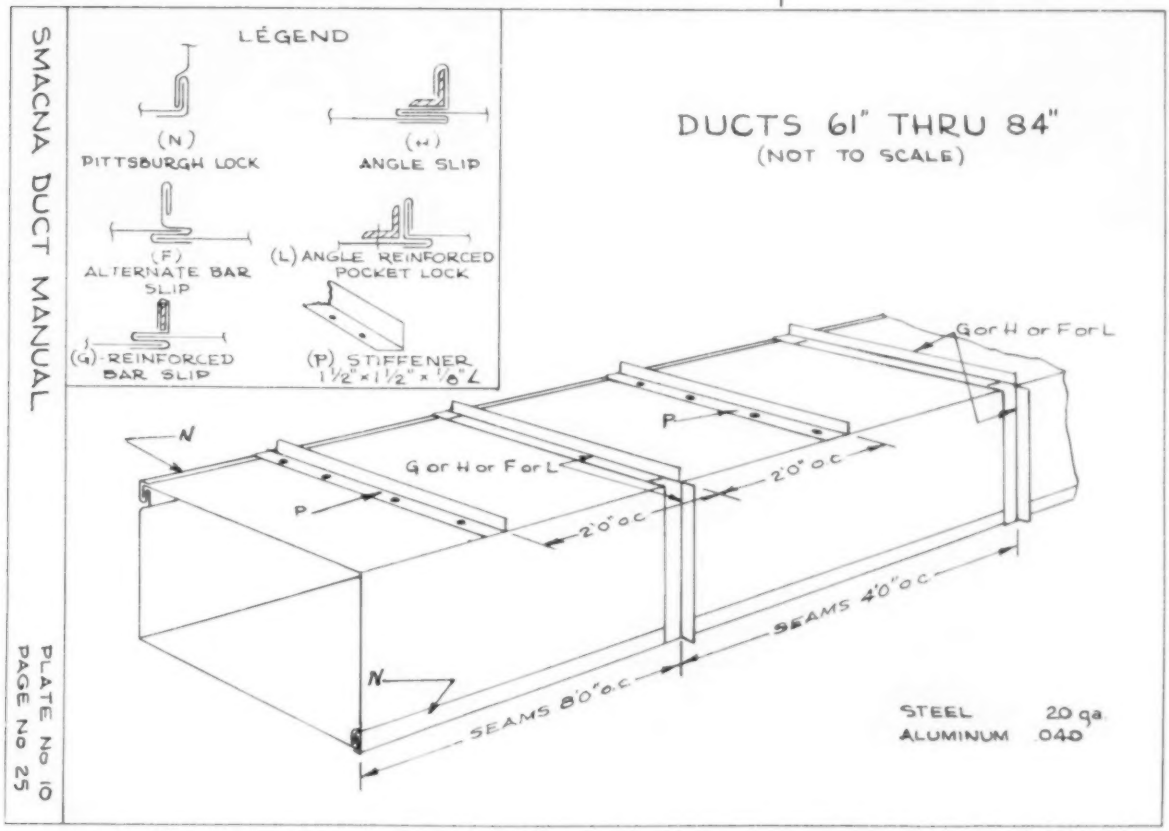
Longitudinal joints shown are Pittsburgh Locks (N) on one or more corners depending upon the size sheets available.

If Reinforced Bar Slips (G), Angle Slips (H), Alternate Bar Slips (F) or Angle Reinforced Pocket Locks (L) are used on 4'–0" centers, 1½" x 1½" x 1/8" Reinforcing Angles (P) are to be placed on center line between joints on sides over 60". Sides under 60" require no Reinforcing Angles as long as joints are on 4'–0" centers.

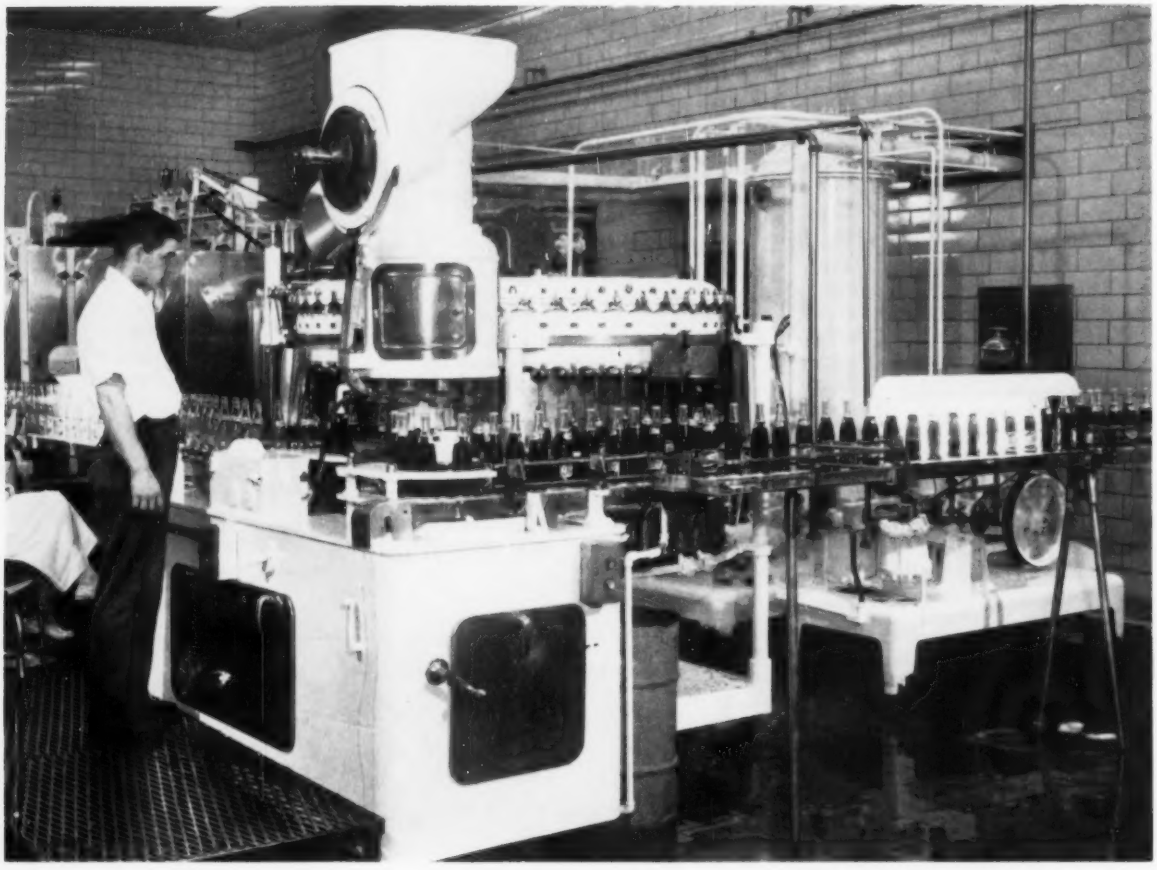
If (G), (H), (F) or (L) are placed on 8'–0" centers, 1½" x 1½" x 1/8" Reinforcing Angles (P) are required on 2'–0" centers between joints on sides 61" thru 84". Use 1½" x 1½" x 1/8" Reinforcing Angles (P) on 4'–0" centers on sides 24" thru 60". Sides under 24" require no Reinforcing Angles.

The Bar Reinforcing in (G) or (F) and the Angle Reinforcing in (H) or (L) is to be of the same strength as the Reinforcing Angles (P).

Steel of 20 gauge or .040 aluminum are recommended for ducts in these sizes.



HPAC Services Meet Peak Demands



FROM MIXING STATIONS to storage tanks to bottling machines, sanitary handling of syrups demands stainless steel piping all the way. Beverage bottling room heating and ventilating is designed to provide sufficient air movement for worker comfort and to exhaust excess heat from bottling operations

SYRUP MIXING ROOM, housing two 1000 gal stainless steel syrup tanks, and syrup storage room are both served by single 147,000 Btu per hr heating-ventilating unit which circulates mixture of filtered outdoor air and return air at rate of 4670 cfm

Careful planning, design spell uninterrupted plant operation

# of New Soft Drink Bottling Plant

PEPSI-COLA's new bottling plant in Louisville reflects careful planning and design of heating, piping, ventilating, and air conditioning systems. These facilities, which will assure uninterrupted bottling and handling operations at peak load conditions, have been installed to require only a minimum of attention.

Two low pressure (12 psi) packaged boilers supply 2 psi steam for plant heating, for heating a hot water storage tank, and to provide process steam for automatic bottle washers.

Each boiler, rated 121 hp, can burn either gas or oil—the provision for oil firing being made against emergency gas shutoff by the Louisville Gas & Electric Co. One gas fired boiler is adequate for the plant's everyday needs; the other serves as a standby. When burning oil, both boilers are put into service at times of extreme outside cold temperatures because of the difference in heat content between the heavy oil used and natural gas. Since only one gas fired boiler is needed for normal operation, the two will be alternated to equalize wear.

In the syrup mixing, storage, and bottling rooms, two separate heating and ventilating units equipped with steam coils provide heated air via duct distribution systems.

The syrup mixing room, with two 1000 gal stainless steel tanks, and the syrup storage room, with three 1000 gal stainless steel tanks, are both served by one of these units. Rated 147,000 Btu per hr, this unit circulates a mixture of filtered outdoor air and return air at the rate of 4670 cfm. The beverage bottling room, housing two large automatic bottling machines, is served by the other unit which has a capacity of 221,000 Btu per hr and handles 7150 cfm. This method of heating and ventilating these rooms was selected because it provides sufficient air movement for worker comfort and carries off excess heat from bottling operations.

During the summer, these units are adjusted so that 100 percent outside air is admitted. In addition, a roof ventilating fan in the bottling room brings in outside air through six large ceiling registers.

At the beginning of the heating season the roof fan is turned off and the dampers in the heating and ventilating units are set to admit 20 percent outside air. This amount is maintained throughout the heating season. Room thermostats in the syrup and bottling rooms control the steam coil temperature.

Pipe Syrups via Stainless Steel

Stainless steel piping systems, for handling syrup mixes from the mixing stations to storage tanks and then to bottling machines, are used to prevent changes in product taste and to resist corrosion which might occur due to the high acid content of the syrup mixes. Likewise, pumps and valves are stainless steel for sanitary handling of the mixes from the storage tanks to the bottling machines.

Copper tubing conveys "purified" water from a storage tank to syrup mixing tanks and to coolers at the bottling machines. In the cooler at each bottling machine, treated water is chilled to 34 F by means of ammonia (because chilled water retains more carbon dioxide in solution).

Exhaust Bottle Washer Heat

Automatic bottle washers use a caustic solution heated by steam coils. As bottles are washed, they are soaked thoroughly in this solution first; then, as they are turned upside-down, jet sprays and bottle brushes clean them inside and out. After three clear water rinses, a conveyor belt moves them along the line where they are inspected and filled.

A power roof exhauster above the bottle washers removes excess heat. As live steam is not used directly for cleaning, there is no excessive humidity build-up in this area.

Warehouse, garage, and truck repair areas are heated by 34 vertical unit heaters installed near the 16 ft ceiling. It was decided that unit heaters would provide the desired temperatures if the thermostats were set at 55 F. One of the reasons for selecting this relatively low temperature is that it would be best for storing the reserve supply of beverage syrups and sugar.

The 14 units serving the garage and truck repair areas have a total capacity of 2,568,000 Btu per hr. The 20 units in the warehouse can deliver 2,424,000 Btu per hr.

Cool Office Areas

For the office areas, a packaged air conditioning unit with a cooling capacity of 15 tons supplies conditioned air through a duct system connected to ceiling diffusers. A steam coil in the unit heats the air during winter. For greater comfort at this time, the diffusers are adjusted to direct the warm air downward.

When nighttime meetings are held in the assembly room adjacent to the office space, two dampers in the ducts leading to this room are opened, permitting the conditioned air to be delivered from the general and private offices. This method was decided upon to conserve cooling capacity in the packaged unit.

Liberty Engineering & Mfg. Co. installed the heating, air conditioning, and ventilating systems for the offices and syrup mixing, storage, and bottling rooms. The process and refrigeration piping systems were put in by Service Engineering Co. C. J. Hoehler was the contractor for the steam heating piping and system components. ‡

The Consulting Engineer's *Two Points*

A Consulting Engineer Says:

Ralph Westcott has been a consulting engineer since 1949 and has been self employed for 30 of his 35 working years. He is a principal in the firm of Holladay & Westcott, consulting engineers. Author of numerous articles on various phases of engineering, Mr. Westcott is a member of several professional engineering groups. Currently, he is national president of the Consulting Enginners Council.

"The consulting engineer's professional responsibilities are threefold: First, he must have technical competence and exert sound engineering judgment. Second, he must be a good businessman. Third, he must be a credit to the profession he serves."

CONSULTING ENGINEERS, like all businessmen, are obligated to provide competent services and products. In return, they are entitled to an honest profit.

There are many qualities of service and knowledge which, when combined, determine the competency of the engineer. Collectively, we can call these professional responsibilities which may be classified into three general groups, none of which are subject to exact evaluation.

The first group relates to the qualities of technical competence and judgment. In the eyes of the public, these qualities almost solely constitute the consulting engineer's reason for existence. Only upon experience, usually as a client, does the public come to realize that there are other responsibilities absolutely essential to the implementation of the first.

Be a Good Businessman

The second group covers business and contractual affairs. As long as we attempt to maintain our free enterprise system, it is the social and economic responsibility of everyone engaged in a business enterprise to make it profitable. This means then that a consulting engineer must know his costs of operation and how to establish fees that will produce a profit from his services.

It has been said that consulting engineering is a high risk business. The establishment of the scope of work to be performed by the engineer is the dual responsibility of the client and the engineer.

There are bound to be grave misunderstandings on the part of both, unless a clear agreement exists on the services to be performed by the engi-

(Continued on page 114)

Responsibilities and Fees:

of View

An Engineering Contractor Says:

"The general feeling among consultants designing air conditioning systems is that their fees are too low. . . . It must be generally conceded that they are much too low. . . . The client will pay a reasonable increase in fee to get a substantial gain if and when he is convinced the gain is real."

A. I. McFarlan, a Lehigh University graduate, was associated with York Corp. for 14 years. He served as vice president of Kerby Saunders, Inc., engineering contractors, resigning in 1945 to form the air conditioning and heating contracting firm, A. I. McFarlan Co., Inc., of which he is president. He is a member of the MCAA's national air conditioning committee and the technical coordinating committee of the ASHRAE.

CONSULTING ENGINEERS designing air conditioning systems have problems. Of course, consulting engineers in other fields also have problems, but for reasons which may not appear on the surface, the air conditioning industry seems to present more difficult problems than the building industry in general.

Problems are not limited to the consultants alone. Look over the diversified manufacturers—big and well-known companies—who have gotten into (and, in some cases, out of) the air conditioning industry. Not all of them can show the success, either profitwise or equipmentwise, that is shown in the broad field of equipment many diversified companies manufacture. From this it might reasonably be concluded that air conditioning is a specialized industry.

Now, let's investigate this reasoning as it applies to the consultant and his problems. The general feeling among consultants designing air conditioning systems, is that their fees are too low. For the moment limiting the reference only to consultants handling large air conditioning projects for architects, it must be generally conceded that the fees are *much too low*. Yet, the fees are insignificant in relation to the variation in costs of large projects. An analysis of cause and effect necessarily must be controversial, since an obvious solution already would have been accepted. It is equally true that to improve the fee situation something must be changed. If the door to changes is closed, there can be no solution.

Much talk about the problem to date has not solved it. Beneficial though it may be, repetitive engineering to reduce engineering costs is at best a temporary measure.

(Continued on page 115)

A Consulting Engineer Says:

(*Continued from page* 112)

"The consulting engineer is pledged to place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations."

neer. The consulting engineer is undoubtedly better aware of the many intangibles, uncertainties, and variables he will have to evaluate and on which he must render judgment than is his client.

The more experienced consultant is better able to evaluate preliminary unknowns than the less experienced. The new entrant into the consulting field is anxious to establish himself and build a reputation. But through his lack of experience he may unwittingly enter into unprofitable contracts for his services. Occasionally he will not know he is in an unprofitable venture until he is well along with the project. Then he suddenly realizes that the agreed upon fee is inadequate to cover his costs.

The engineer who knowingly reduces his fee in anticipation of skimping or minimizing the services that the project demands, discredits himself and his profession. The consulting engineer therefore has an obligation to require a fee that will be adequate for him to fulfill his professional obligation and render complete and competent services.

When an engineer makes a practice of providing incomplete engineering, even though his fees are low, and he still makes a profit, he may think he is a smart businessman. The only way that he can consistently practice this philosophy is by getting new clients who are unaware of what is required of a true professional.

Live up to Professional Ethics

That leads to the third category: professional and ethical considerations. The consulting engineer is pledged to place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations.

As a professional, he is obliged to use his training and talents to the best of his ability, to serve his client and the public, and in turn bring credit to his profession. An active conscience backed up by integrity is a prime professional attribute. His conduct must be such that he avoids the petty or dishonest acts which would destroy his value as an unbiased and objective consultant.

The consulting engineer cannot have commercial affiliations which would bias his judgment. He cannot accept gratuities, commissions, nor kick-backs from vendors as justification for specifying their products.

Fees Determined Various Ways

With these professional responsibilities as a background, he can now discuss the question of fees. There are at least a half-dozen ways to arrive at a fee for engineering services. Historically, the percentage of construction cost has been accepted as the predominant method. But there are many fallacies in this method, and the outstanding one is that it is basically not to the best interest of the client.

Engineers, like all other people in business, are subject to the same temptations and weaknesses where money is concerned. Under the percentage fee basis, the more thorough and economic the engineer's design, the lower the cost will be to the client. But, by the same token, the engineer is working to reduce his own fee by this procedure.

Many will say that, since this is such a widely accepted basis for fees, the individual engineer cannot afford to buck the tide. In my opinion, if he does not buck this fallacy of a business relationship, he cannot be honest with himself professionally in his rendering of technical judgment.

He is forced to do one of two things: knowingly increase the cost of the project to build up his fee, or do a competent engineering job and lose money.

Must Find Some Other Basis

With many engineering services there are no direct relationships between services rendered and construction costs. On this premise the engineer must find some other basis for establishing his fees.

If the scope of the work can be clearly defined when the project is initiated, it is possible to estimate a lump sum fee that will be equitable to both client and engineer. If this scope cannot be clearly defined, the only logical basis for a fee will be hourly or per diem charges; cost plus a multiplier; or cost plus a fixed fee.

When any fee is established, it must be based on the services to be rendered. Engineering services are of many kinds and complexities. The type of service which is most generally performed is the preparation of detailed plans and specifications to be used as the basis or guide for construction. At both ends of this service are many other related problems which should be included in the engineering service contract.

For example, before any project is

(*Continued on page* 116)

An Engineering Contractor Says:

(Continued from page 113)

"A consultant owes it to his client to accept that which will give him the best overall results from whatever source it comes. . . . He is of use to a client only when his advice is without bias."

There are many other consultants who are cost-conscious engineeringwise, especially in big cities. They soon follow the leader, too frequently disregarding the problems and specifying that which is most commonly accepted, and that which costs less to engineer. The unsolved problems remain, but are a clue to the solution of the fee situation.

If the fee situation is to be solved then it will be because the client is convinced the consultant has reduced his first cost and operating expense. Too much of the consultant's service is concentrated on the "necessary evil" attitude, i.e., preparing plans, meeting codes, etc. The client will pay a reasonable increase in fee to get a substantial gain if and when he is convinced the gain is real.

A consultant owes it to his client to accept that which will give him the best overall results from whatever source it comes. In such acceptance, he furthers his own ends and he serves a most necessary function. But he is of use to a client only when his advice is without bias. Some consultants are finding it necessary to recognize important improvements, disregarding that which is the easiest for the engineer to design. Their fees must necessarily be higher, but the resulting contract prices will be lower by many times the difference in fees. The more they can eliminate bias, the more the industry will grow. It may even become more profitable to improve an overall system by tackling the problems and specifying equipment which overcomes the inherent inefficiencies. This is a real challenge to consultants.

Engineering Contractor's Lot Is Easier

In the engineering contracting business, especially when a sincere desire exists to give the most to the customer for his money, it is relatively easier to increase the engineering costs. If, by making constructive changes, the overall price either remains the same for improved performance or if the contract price is reduced for the same or improved performance, then the only problem is to convince the customer.

The consultant, necessarily maintaining a rigid budget on engineering costs, too seldom finds these possibilities. Even if he deals through an engineering contractor, he seems jealous of the contractor's right to suggest engineering changes even though an improvement will result. This is especially true if a method change is involved. The consultant is generally very suspicious of engineering contractors, it seems to me.

Examine Clues to Solution of Problems

Therefore, the possible solutions go unrecognized. This analysis is, however, a clue to the solution of many problems—including low consultant's fees. Let's see what happens under the present order:

1) *Lowering engineering costs to meet competitive fees* vs *solving problems which reduce overall customer costs and improve end results*: Many engineers have good ideas to reduce overall costs of projects probably inversely in proportion to being tied down to meet engineering costs on currently accepted methods necessarily taken at low fees. Most engineers will also agree that they receive no marginal time or money to justify accepting responsibility for methods untried by them, whether they result in benefit to clients, or have been proven through use by others. Almost always this results in continuing old established ways for which extensive data is available, presented in a manner that can be used by the staff members with the least possible lost time in checking or investigating. Engineers tell us there just isn't time for research if the rent is to be paid and a little left over.

2) *Overall responsibility* vs *individual equipment responsibility*: Under today's scheme of things, the consulting engineer holds the overall responsibility for end results. As a professional man, he feels he would not want circumstances to be otherwise. This responsibility is probably more complex in the air conditioning field than in any other major part of the building industry, and is increasing in complexity as new equipment comes on the market. More responsibility for lower fees just does not make sense, and lowering of the consultant's fees as his engineering costs are reduced merely makes a bad matter worse.

3) *Engineers' overall responsibility* vs *suppliers' limited responsibility on many component parts*: To illustrate a point, let's assume that a responsible water chilling unit manufacturer furnishes equipment and guarantees it for certain operating conditions which occur only a few hours per year. At all other times, this guarantee is voided due to many factors, which include:

a) The water pump supplier may have furnished a

(Continued on page 117)

A Consulting Engineer Says:

(*Continued from page* 114)

"Engineering reputations are not built on the basis of fees charged. Rather, they are built on the professional performance of the engineer."

initiated, certain preliminary investigations should be made to determine its feasibility, and probably some preliminary cost estimates for funding purposes. If a site and feasibility have been established, preliminary engineering is required to determine the basic methods of fulfillment.

After the detailed designs and specifications are completed and a construction contract awarded, the engineer's services extend to construction supervision, checking shop drawings, approval of payments, and, where required, preparation of operation and maintenance manuals. When an attempt is made to wrap up all these potential services with a fee based on cost of construction, many inequities are bound to develop.

Even in the rather confined area of preparing plans and specifications there is a wide latitude possible in the way these services are performed. As a specific example, the calculations for an air conditioning system can be by rule of thumb on a square foot basis or they can be quite detailed. Complete engineering calculations and evaluations would include orientation of building, sun effects, materials of construction, glass, insulation, occupancy, design temperatures, weather conditions, equipment space, type of air distribution, outdoor air requirements, refrigeration capacity, control system, zoning, and relative costs.

After these calculations and evaluations are made, the next step is to put this information into graphic form. Drawings and specifications should be done in a manner that will be clear to all potential contractors as to just what the engineer expects to have done to fulfill his objectives of performance. Everything must be sufficiently detailed so that the contractor will be able to follow the design intent.

When a contractor questions an engineer's design, he should be heard. If his ideas are good, the engineer should use them, if at all practicable. After all, contractors acquire a lot of practical experience in construction problems not always available to the consulting engineer.

Always Give Your Best

No matter what the project is, the client is entitled to the best that the engineer can produce, regardless of the fee. If the fee is too low, it is likely that the engineer is more than 50 percent responsible for its being too low.

If the fee is too low because of a change of scope, it was the engineer's responsibility to have made contractual provisions for this eventuality when the contract was negotiated. If it was due to ignorance on the part of the engineer as to the extent of his services, this is still largely his fault. If he just plain cut his fee to get the project, this should not excuse his obligation to perform a complete and competent job. Next time, he should know better. Of course the easiest way out is to accuse the client of taking advantage of him.

The actual negotiation of a fee depends on many variables. To argue over a difference of 1 percent or 2 percent would appear academic. The engineer should obtain sufficient information on a project ahead of a fee negotiation to know rather specifically what scope of services he is to render.

Engineering hours with appropriate hourly rates can be estimated for each phase of the work called for in the scope. When these are totalled, they will represent an approximate dollar value for his fee. If there is a reasonable total construction cost estimate or budget figure available, his total can be related to a percentage of this construction cost estimate.

If the engineer is unable to negotiate a fee which he believes is essential to cover the services he expects to render, it would be better for him to turn down the project if he cannot honestly revise the scope of his work and clearly show this revision to his client.

Good Work Builds Reputations

Engineering reputations are not built on the basis of fees charged. Rather, they are built on the professional performance of the engineer. The old adage that the quality remains long after the price is forgotten is as true here as elsewhere.

There are arguments — and valid ones — that the difference in fees may be the result of different efficiencies in various engineering offices. Certainly, it is true that no two offices will operate the same. But the variable in efficiency is not broad enough to account for the apparent wide variation in fees.

The final solution to the fee problem is therefore the responsibility of the engineer. He must educate the public and his clients as to the actual value of his services. This can only be done through the concerted efforts of all consulting engineers. Then they must live up to the responsibilities that those fees justify. ‡

An Engineering Contractor Says:

(*Continued from page 115*)

"Consultants should investigate better methods before issuing plans and specifications. . . . A bidder should not have to convince an engineer that his design could be improved."

pump whose capacity varies along a definite curve, while the automatic control of another manufacturer may provide changes in water quantity. This, in turn, affects temperature range, which may be beyond the minimum efficient capacity or even the critical minimum to prevent freeze-ups in the water cooler. If the result is a freeze-up, none of the equipment manufacturers will accept any responsibility.

b) While the water chilling unit may have sufficient capacity at full load and at the stipulated water temperature, coils furnished by various manufacturers produce many different combinations of moisture removal and sensible cooling for the specified water temperature and quantity. This may result in either inadequate moisture removal and high humidities, or failure to obtain dry bulb temperature due to too much moisture removal. Summer reheat and coil bypassing are, at best, limited solutions. They apply only to the overall system, rather than to zones or individual rooms where temperature and humidity control is frequently necessary.

Summer reheat may result in expensive operation and reduction of effective capacity. Automatic volume control provides temperature regulation in either zones or individual rooms. Lower humidities at reduced room temperatures are obtained automatically by taking advantage of capacity customarily lost by reheat.

These are only two of a number of costly situations which can be corrected by an entirely different overall approach. But consultants, for reasons already discussed, are sometimes reluctant to accept broad changes and tend to hold on to the known and previously used. They may fail to accept that which would help them solve their problems—and make them more valuable to their clients. Equipment changes, yes; overall method changes, no.

Thus far, it might be concluded that the air conditioning consultant is up against a peculiar combination of circumstances where he can't possibly win. However, there is seldom an engineering or business problem for which there is no solution.

First, Investigate Better Methods

Consultants should investigate better methods before issuing plans and specifications. But improvements should also be recognized and fairly evaluated at any stage of the bidding. Too often, it seems to me, the engineer cites time as an excuse for avoiding desirable changes when changes could be the improvement a client will appreciate most. Changes can even salvage a project that otherwise might be abandoned.

If beneficial changes can be made at any time, then rejection hurts everyone, including the consultant. The engineer should have an understanding that his fee, if on a percentage basis, should never be cut by making such changes. If changes are made in the plans and specifications, the consultant's fee should be increased in proportion to the savings, or by the added expense involved. It may take a few trials to prove this truth, but the principle is sound. Again I can testify that customers appreciate beneficial changes at any stage of a project.

It's Up to the Engineer

The engineer must initiate this changed procedure. A bidder should not have to convince an engineer that his design could be improved. Pride of authorship is frequently so strong as to preclude fair judgment of a better system by a consultant when he is the designer of an inferior one.

For a starter, the following suggestions are offered:

1) That consultants and architects re-appraise the competition *vs* the value of established reputable engineering contractors, especially those with competent service departments.

2) That they investigate new methods more thoroughly, and encourage the use of them. The risk of difficulties can be no greater than those resulting at present with conflicting combinations of presently accepted equipment.

3) Where improvements have proved their value and where the customer may receive a guaranteed performance, consultants should be more willing to accept changes.

4) If no penalty is incurred, the installation of air conditioning equipment should be given to those companies who know air conditioning and who have a reputation for producing good overall results — rather than limiting consideration to compliance.

Several consulting engineers and manufacturers' representatives have read and criticized previous drafts of this article. Their opinions weighed heavily in this final presentation. The many comments are hereby acknowledged and my appreciation is expressed for them.

ROOFTOP LOCATION of air conditioning equipment saves valuable floor space for storage of photographic supplies. All mains and steam pipes are exposed. Individual air conditioning units, rear, have foamed plastic insulation, are painted to reflect sunlight

Rooftop Air Conditioning Systems Keep Photo Supplies Fresh

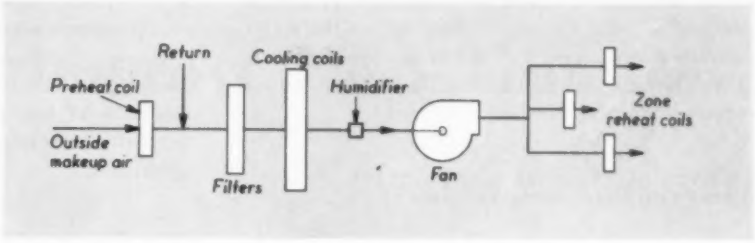
THIS 750 TON compressor-condenser supplies 35 F brine to cooling units on roof of recently constructed addition of 115,000 sq ft of storage space

• Air conditioning maintains controlled temperatures and relative humidities in Eastman Kodak Co.'s distribution center building so perishable photograhic supplies can be kept fresh prior to shipment. Comprising seven systems in all, the installation provides cooling to offices, cafeteria, and an electronic computer installation, in addition to the storage areas.

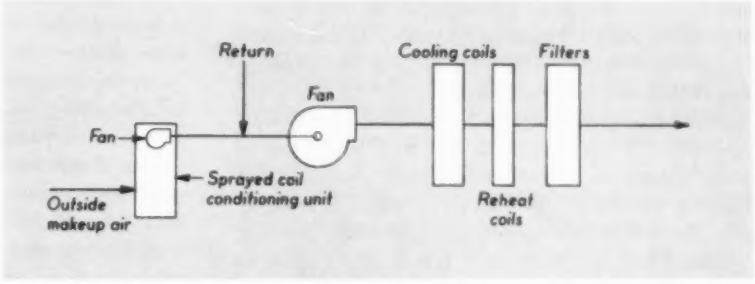
Mr. Quadrini received his mechanical engineering degree from Syracuse University in 1949. Following two years' Army service as an industrial engineer in the U. S. Army Ordnance Dept., he joined Eastman in 1952.

Built-up systems follow two different operating principles

1 DRAW-THROUGH systems are used in areas where air cleanliness is not important consideration



2 BLOW-THROUGH systems have high efficiency, high resistance filters which minimize infiltration of dirty air



BY L. V. QUADRINI
Mechanical Engineer
Eastman Kodak Co.

EASTMAN KODAK CO.'S distribution center building in Rochester, N.Y., has installed air conditioning for half of its floor area. Although this facility, used for storage and shipping of photographic products, is predominantly a one-story structure, its west length has two stories. The first floor provides an area of 680,000 sq ft and is complemented by the second floor's additional 227,000 sq ft.

Initially, the air conditioning systems were designed and installed only to provide specific conditions of temperature and humidity essential for maintaining the uniformity of photographic products stored. Later, the ventilation systems, originally installed for the offices, were converted to comfort cooling. In a recently constructed addition, comfort air conditioning was provided initially.

Uses Both Built-up, Package Systems

The air conditioning systems installed are basically of central station design, either built-up or package unit type. For areas of 13,000 sq ft and larger, the built-up system has been predominant. The number of applications of built-up systems are shown below:

Systems	Areas	Zones	Air flow rate, cfm
4	Offices	2 to 6	28,000 to 64,000
1	Offices and cafeteria	5	42,500
1	Electronic computer	4	56,000
1	Product storage	1	55,000

In general, all the systems installed are of a draw-through design, as shown in Fig. 1, except where air cleanliness is of prime importance. Here, the blow-through system illustrated in Fig. 2 is utilized. The air filters for this latter system have high efficiency, high resistance qualities. By using the blow-through principle, the chance of infiltration of dirty air is minimized.

In multi-zone areas, pneumatic low-pass relays in conjunction with the zone thermostats provide temperature control. The thermostat for a particular zone, sensing a need for cooling, sends a low air pressure signal to the low-pass relay. Relays for the other zones allow this low pressure through to open the cooling coil valve thereby lowering the air temperature leaving the cooling coils to satisfy the requirements of this zone. Other zones, not in need of cooling, have individual reheat coils which warm this air to maintain the desired temperature.

The package unit type central station air conditioning systems used are designed to handle small areas and zones within a large area where air distribution and temperature and humidity control are critical. The number of these systems required for each storage area depends, of course, on the cooling load. Temperatures required in different storage areas may be 50, 60, or 70 F dry bulb. Relative humidity for all conditioned storage space is 50 percent.

Air Condition Computer Installation

A built-up central station system with a blow-through design furnishes cooling for two model 705 IBM computers. Relative humidity is maintained within close

tolerances by the dehumidification or humidification of a small amount of outside makeup air through a sprayed coil package air conditioning unit.

The air distribution system is of a single-duct, high velocity design, with air valves which reduce the air to conventional velocities. All the air (48 changes per hr) is distributed through ceiling diffusers. Deep bed pocket air filters provide clean air for the room.

Equipment on Rooftop Saves Space

To conserve valuable storage space, the 21 air conditioning units and the insulated steam, condensate, compressed air, and brine lines (over 10,000 ft of each) are installed on the roof of the one-story section. This arrangement eliminates the possibility of pipe leaks causing damage to photographic products.

The multiple unit installations are zoned in an attempt to cope with the varying humidities and temperatures caused by infiltration of outside air. Since the length of the building faces west, the prevailing winds have little difficulty in penetrating through the large truck loading dock doors of the west to those of the east, and through internal materials handling truck doors as well as the conveying drag line openings between these areas. One central unit would have more difficulty in coping with the varying demands.

Design to Minimize Infiltration

The three-package unit installation with individual controls maintains the desired conditions as follows: In summer, the westernmost systems—sensing the hot, moist air coming from the west—dehumidifies and cools it to the correct conditions. The second system, receiving the infiltrated air after it has been dehumidified and cooled by the first unit, has little trouble in cooling and dehumidifying the air to specifications. The third system functions normally.

Steps have been taken to reduce this prevalent problem of infiltration. Electrical operators with timers have been installed on truck doors. Truck bodies have been curtained-off at the loading doors. Special precautions are taken to keep the large outside doors closed on days when the outside temperature and relative humidity are high.

When the air conditioning systems for a recently constructed addition of 115,000 sq ft of storage space were being designed, the infiltration factor was considered of prime importance. Knowing that the necessary loading doors were the principal cause, the areas were designed so that only two small doors for truck loading were installed on the east wall. Because of this, a considerable saving in refrigeration was realized.

Services available for these systems are 10 psi steam for heating, 26 and 35 F brine for cooling, and 25 psi compressed air for controls. Basically there are two systems, i.e., south and north. The south system has a capacity of delivering 3000 gpm of 26 F brine, while the north's present potential is 2000 gpm of 35 F brine. If greater cooling capacity is required in the future, the north system will be able to supply a total of 6000 gpm of 35 F brine with the installation of two more centrifugal refrigeration machines.

Crossover pipe connections are provided between the two systems so that either system can handle the load in the event of emergency shutdown. During winter, this flexibility permits either equipment room to be down for cleaning or major repairs.

Why Two System Temperatures?

The reason for the two different temperature brine solutions is that the south system supplies the coolant to areas that require 50 F and 50 percent RH, whereas the north's requirements are 70 F and 50 percent RH.

Three fully automatic centrifugal refrigeration machines, rated (two) at 250 tons and (one) at 650 tons, make up the units for the south system. The north's single centrifugal machine, rated 750 tons at 35 F, as well as the two future units of the same size, can be operated at a rated 650 tons each at 26 F if the need arise.

Why Select Brine?

The brine coolant is an inhibited CaCl solution of 1.197 specific gravity at 31.25 F. Its selection over other refrigerants was based on the following reasons:

1) The need for a 26 F coolant for the 50 F, 50 percent RH areas.

2) No freezing problem would exist with brine mains on the roof.

3) The plan to use one refrigeration machine for initial needs, with provisions to add others to complement the central brine system as load requirements increased.

4) The long network of piping mains on the roof to furnish coolant to all parts of the building.

Three induced draft redwood cooling towers produce condenser cooling water. Since redwood will burn readily, sprinkler protection was installed in all three.

Use Three Man Maintenance Team

Since operation of the air conditioning and refrigeration systems is practically fully automatic, only three trained men keep this vast system working continuously around the clock. The responsibilities for each man have been designated such that one handles the routine refrigeration work, another the air conditioning systems, and the third performs work over and above that of a routine nature.

With a flexibility allowance for emergency breakdowns, a schedule has been set up with a check list that covers operations from hourly visual checks to yearly overhaul of all equipment.

Through air conditioning, Kodak has been able to maintain the quality of its products so that they reach the photo dealer as fresh as when they were made. ≠

Filming Amine Inhibitors Control Corrosion, Improve Heat Transfer

. . . *in steam heating systems*

● Filming amine corrosion inhibitors, which function by formation of oriented, nonwettable films over metal surfaces, can provide economical, efficient protection against corrosion and certain types of surface fouling for steam heating systems. These inhibitors also exhibit "detergent" action on already fouled surfaces, displacing and removing corrosion deposits and other fouling layers. They apparently promote dropwise condensation and "sweeping" run-off, which also contribute to increased heat transfer. Theoretical calculations, confirmed by field tests and observations, indicate that appreciable gains in heat transfer can be realized through removal of fouling layers and promotion of improved condensate action.

Dr. Obrecht, holder of a PhD degree in chemical engineering from Michigan State University, has a broad industrial background. He is experienced as a full-time research and development engineer, as an advisor to presidents of several midwestern firms, and as an active consulting engineer. A noted authority on water treatment, corrosion, and steam and power, he is a member of the Boiler Code Advisory Board for the State of Michigan. Since 1949 Dr. Obrecht has been an adult extension lecturer on water treatment and power plant operations throughout Michigan. Currently, he is engaged in several research projects at Michigan State. A member of numerous technical societies, he is listed in *American Men of Science*, *Who's Who in American Education*, and *Leaders in American Science*.

BY MALVERN F. OBRECHT
Water Treatment Consultant
and Professor of Chemical Engineering
Michigan State University

BACK IN THE mid-'30s, a patent was issued covering the use of various materials to increase heat transfer by promoting dropwise condensation[1]. It was shortly after this that a classical treatise on the occurrence, causes, and mitigation of corrosion in steam heating systems was published[2].

This work led to general understanding and acceptance by engineers of the causes of corrosion in steam condensing systems. Corrosion was attributed to carbon dioxide evolved with the steam being generated and having its source in the makeup water, either in the form of bicarbonate ions or as free carbon dioxide.

Gaseous carbon dioxide reacts with condensed steam to form carbonic acid. This acid attacks both the condensing equipment and the condensate return system. If oxygen is present, pitting of the metal will occur and corrosion deposits may be expected. As shown in Fig. 1, corrosion rate is a function of quantity of condensate contacting the metal, as well as the carbonic acid content[2].

It is interesting to note that, through the years, various means have been employed to reduce and remove the potential carbon dioxide and dissolved oxygen. The use of dealkalizers or chloride regenerated anion exchangers in series with sodium softeners is one of the more recent developments. Hot lime-zeolite, split stream, acid feed, demineralizer, and evaporator makeup systems followed by degasification and deaeration all have their advocates.

Return Line Corrosion Still a Problem

In spite of the use of these elaborate external means, return line corrosion is still a problem which may be aggravated locally because of certain mechanical features. Undersized pipes and traps, pocketing of gas due to faulty layout, and flow rates exceeding critical velocities all may contribute to increased local corrosion. It is not always economical or practical, particularly in existing low pressure boiler systems, to install the external equipment necessary to pretreat feedwater to remove the source of corrosive gases.

To protect condensate systems by chemical means, volatile alkaline materials have been employed. Ammonia and amines such as cyclohexylamine, morpholine, and

benzylamine[6] have found wide use in steam systems for corrosion control. Using these agents, protection is obtained by neutralization of the carbonic acid (and other acidic gases) in the condensate, and by increase in pH. This method requires close monitoring to assure maintenance of the correct pH values throughout the system at all times. Since these neutralizing amines must be fed in proportion to the acid present, they become expensive when the carbon dioxide concentration in the steam is high. Uniform distribution of the amine re-agent is often difficult to control.

Amines Form Nonwettable Film

Inhibitors which afford corrosion protection by the formation of a nonwettable film over the systems' surfaces have been developed[5]. They do not function by neutralization, and their performance is independent of dissolved gas concentrations. Numerous articles have appeared recently on the effects of these filming materials in reducing and controlling return line corrosion in industrial steam plants and other condensing systems[5,7,8].

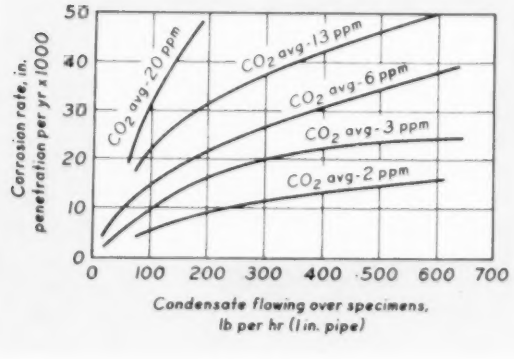
The filming inhibitors commonly employed today are the straight chain primary amines (10 to 18 carbon atoms) or their salts. Unsaturated straight chain primary amines, branched chain, or unsaturated secondary or tertiary amines are less effective inhibitors than straight chain primary amines. The latter group appears to give the best orientation and closest packing on the metal surface, and, hence, the best inhibition against corrosion.

The most effective filming inhibitors at present are the commercially available octadecylamines and their acetate salts. Two principal commercial grades of the solid flaked, waxlike octadecylamine acetate are available. One consists essentially of octadecylamine acetate, the other is about 80 percent octadecylamine acetate, with the balance being essentially hexadecylamine acetate. Octadecylamine and its acetate salt also can be obtained in emulsion form.

Commercial octadecylamine is approximately 70 to 80 percent active amine and is readily dispersed in hot distilled water or condensate and will give stable solutions if properly prepared. To obtain a proper feed solution, a smooth slurry first is made by stirring 1 lb of the flaked material into 1 gal of condensate. This slurry is then diluted to the desired feed concentration by stirring in hot condensate. For ease in pumping, feed solution strength should not exceed 1 percent concentration. If the solution temperature is maintained about 100 F, pump plugging will not be a problem.

An alkaline emulsion of octadecylamine containing 100 percent active amine is available. This emulsion is easily dissolved in condensate or tap water at 130 F. It forms a stable 1 percent solution with a pH of approximately 9.5. This high pH eliminates problems of corrosion of feed equipment. Unlike octadecylamine acetate, the 100 percent active emulsified octadecylamine is compatible with many other water treatment chemicals. Field results show that successful corrosion control can be obtained with the octadecylamine materials when fed either directly to the boiler or to the steam header. Field tests also indicate that, for maximum protection, the material should be fed continuously. Laboratory studies have shown that if the inhibitor feed is discontinued, corrosion rates are quickly attained[5].

In highly corroded condensate systems, octadecylamine will lift or loosen and displace existing corrosion deposits. Therefore, when starting filming amine treatment, serious clogging of traps and screens may be experienced if the amine is fed at too high an initial rate. This situation has been particularly troublesome in systems that were very badly fouled and contained large amounts of corrosion deposits. Such problems can be minimized and satisfactory corrosion control obtained if the initial feed is at a rate of 0.5 ppm, based on steam production. After the system becomes clean, feed rate is then gradually increased to 1 to 3 ppm. This dosage range has been found to produce 90 percent or greater corrosion reduction in most plants. Field results indicate that optimum protection is not reached in some systems for six months; however, appreciable reduction of corrosion is usually obtained within 30 days after starting filming amine application. The higher dosages (2 ppm and above) are recommended for plants that have large surface areas in distribution and return systems in relation to the actual condensing system[5].



1 CORROSION RATE is a function of condensate contacting metal, as well as carbonic acid content. These relationships between corrosion and gas content of condensate exist when varying quantities of condensate are flowing

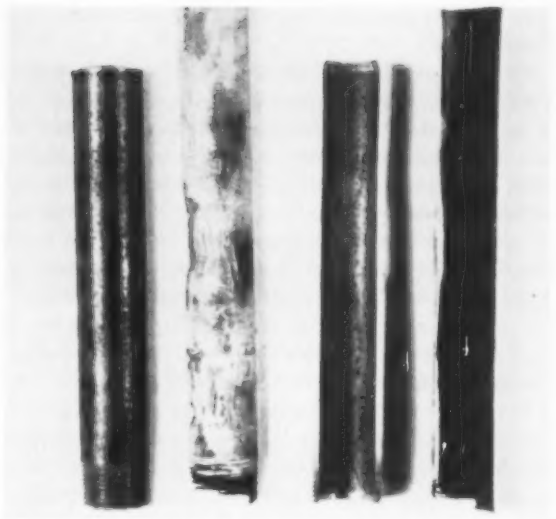
Must Choose, Equip Test Points Carefully

One cannot over emphasize the importance of properly selecting and equipping test points within a given system to accurately measure the degree of protection[4]. NDHA-ASTM testers are simple in design and easy to install. They are more satisfactory than either coupons or test nipples in evaluating initial corrosion rates or in testing the effectiveness of inhibitors. The rapid, triplicate corrosion rate measurements obtained using the NDHA tester provide accurate, inexpensive, proper monitoring of corrosion control in the systems.

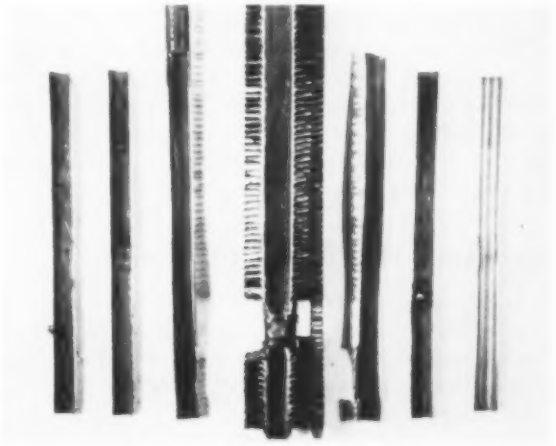
One could cite numerous cases where corrosion has been reduced to a minimum by the proper application of the film forming octadecylamine. Several thousand steam plants of various sizes, pressure ranges, and types are now using this filming amine corrosion inhibitor today. This material has been particularly effective in arresting corrosion attack in copper or copper alloy space heaters at locations where such units formerly experienced high rates of failures.

Fig. 2 shows a typical return line failure caused by carbonic acid corrosion. Inspection will show failure of the threaded end and thinning of the pipe wall, as compared with undamaged pipe fully protected after filming amine was applied.

Fig. 3 shows one of the most frequent causes for rapid failure of space heaters, namely, washing action in the lower section of the tubes. This washing action greatly increases the corrosion rate in a narrow band across the heater core. Proper sizing, location, and maintenance of traps will reduce failures of this type. Filming amine treatment will reduce the corrosion in space heater units, but is not a cure-all for improperly designed and trapped systems. For maximum corrosion protection, good design practices in sizing and laying out a system must be followed. A critical inspection of the entire heating system will often reveal an unbelievably high number of poor practices. In a well designed system, carbonic acid corrosion can be arrested by proper filming inhibitors.



2 THIS RETURN LINE FAILURE (second from left and right) was caused by carbonic acid corrosion. Note failure of threaded end and thinning of pipe wall, as compared with filming amine protected pipe (left and second from right)



3 ONE OF THE MOST frequent causes for premature failure of space heaters is washing action in lower section of tubes, evidenced here

Filming Inhibitors Increase Heat Transfer

In recent months marked increases in production rates have been observed in certain paper mills and in other industrial systems where the filming amines are employed for corrosion control [3,8,9]. Increases in production appear to result from the ability of the filming inhibitors to contribute to increased heat transfer. Such increases might result from reduction of the fouling factor on the steam side, and/or the promotion of dropwise condensation of the steam, and/or better runoff of steam condensate from the heat transfer surface.

A critical review of the heat transfer theory attests to the theoretical possibility of such increases under certain conditions, and reveals the conditions necessary for "pure" dropwise or film condensation[10,11,12,13,15]. No literature references could be found citing pilot plant or laboratory work done to confirm the effect of octadecylamine or any other filming corrosion inhibitors on increasing heat transfer. In fact, the use of materials for promoting dropwise condensation appears to have been only of academic interest.

Fig. 4 shows the theoretical effect of filming corrosion inhibitors on heat transfer. Condensation of steam is accomplished upon contact with a cool surface. In most cases, condensation occurs as a continuous film of liquid —this phenomenon being designated as filmwise condensation. Such a film offers a relatively high resistance to heat transfer. In a corroded system there may be much additional heat transfer resistance caused by corrosion product layers or other contaminants. This is commonly referred to as the fouling factor. Fouling factors may account for an appreciable resistance. Theoretically, when a fouled or corroded system is treated with a filming inhibitor, such as octadecylamine, the corrosion layer or

fouling factor should be removed and a nonwettable film formed.

Field observations in octadecylamine treated systems have confirmed the reduction of the fouled layer and the production of nonwettable surfaces. Experimentally, it has been shown that condensing steam forms as droplets when condensation occurs on a nonwettable, nonfouled surface. It has also been demonstrated that the droplets of condensate exert a sweeping action as they run down a surface. This produces an area of high heat transfer. The cycle is then repeated with formation of more droplets of condensate. Whether it is possible for droplets to form and run down at such a high rate that a continuous film is created is still an open question.

In rotary heat transfer units (such as paper mill dryer rolls), speed of rotation, gravitational forces surface conditions, and viscosity of condensate, etc., affect the extent to which condensate films will be carried up the rotating surfaces. The *rimming speed* is the peripheral speed at which condensate is carried up and around the inner drum surfaces to form a continuous layer.

It has been reported that paper machines are operating efficiently at speeds higher than theoretical rimming speed in plants using filming amines[9].

The net effect of eliminating the fouling factor and having steam condensed as droplets is the production of a higher surface temperature at the interface between the metal and the material being heated or dried. (See Figure 4B). This higher surface or skin temperature gives a greater driving force for heat transfer.

Must Analyze Heat Tranfer Relationships

To determine the net effect on overall heat transfer it is necessary to analyze any given setup in the light of fundamental heat transfer relationships as applied to that system. This is done mathematically as follows:

$$Q = U A (\Delta t)_m$$

where:

Q = heat transfer rate, Btu per hr
U = overall coefficient, Btu per hr per sq ft per F
A = heat transfer area, sq ft
$(\Delta t)_m$ = logarithmic temperature difference, F, or driving force.

$$R = f(R_s, R_f, R_m, R^*)$$

where:

R = resistance to heat transfer
$R_s = 1/h_s$, $R_f = 1/h_f$, $R_m = L/K = 1/h_m$, $R^* = 1/h^*$

Assuming A = constant:

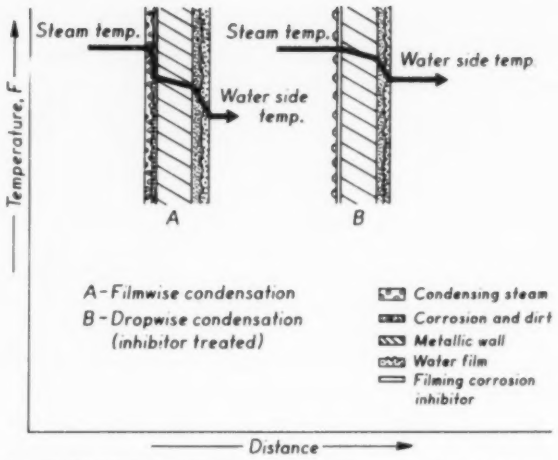
$$U = [1/[R_s + R_f + R_m + R^*]] = [1/[(1/h_s) + (1/h_f) + (1/h_m) + (1/h^*)]]$$

where:

h_s = steam side film coefficient, Btu per hr per sq ft per F
L = thickness of metal wall through which heat is transferred, ft
K = thermal conductivity of metal, Btu per hr per sq ft per F
h^* = liquid, air, or sheet film coefficient, Btu per hr per sq ft per F
$1/h_f$ = fouling factor due to corrosion, product, dirt, etc., 1 Btu per hr per sq ft per F.

In a simple heat exchanger the mean can be calculated as follows:

$$(\Delta t)_m = [(T - t_1) - (T - t_2)]/[l_n (T - t_1)/(T - t_2)]$$



4 THEORETICAL EFFECT of filming corrosion inhibitor on heat transfer shown here

where:

T = mean temperature of condensing steam, F
t_1 = temperature of incoming material at point which first contacts exchange surface, F
t_2 = temperature of outgoing material at point last contacting exchange surface, F.

The theoretical effect of the filming inhibitors on heat transfer may best be illustrated by considering typical systems employed for heating liquid, heating air, or drying material like paper. Data applicable to such systems is summarized in the paragraphs that follow. Complete calculations, sources of values, equations, etc., are too extensive to be included. They are, however, in accord with acceptable design practice and field observations [16,17,18,19,20].

The resistances (R_f) used to show the differences between a badly fouled steam side and a minimum fouled steam side are 0.020 and 0.0005, respectively[20]. For film condensation of steam, a conservative film coefficient (h_s) of 1000 was used. In many cases, measured values of h_s have been as low as 600. A steam side coefficient (h_s) of 10,000 was used for dropwise condensation. This also is a conservative value since dropwise coefficients as high as 70,000 have been reported[14]. In all cases, a zero fouling was assumed on the side being heated.

Evaluate Overall Effect of Inhibitor

In order to show the maximum possible benefit by reduction of the fouling factor and the promotion of dropwise condensation, individual resistances have been tabulated as percentages of the total heat transfer resistance. These calculations illustrate the increase in overall coefficient U possible by complete elimination of any one resistance. By analysis of a given system, using fundamental heat transfer relationships, the overall effect of the filming inhibitor can be evaluated. It should be borne in mind that the capacity of any heat transfer system is directly proportional to Q, or the heat transferred per hour.

● *System A: Heating or boiling of water or comparable liquid in heat exchangers, evaporators, etc.*

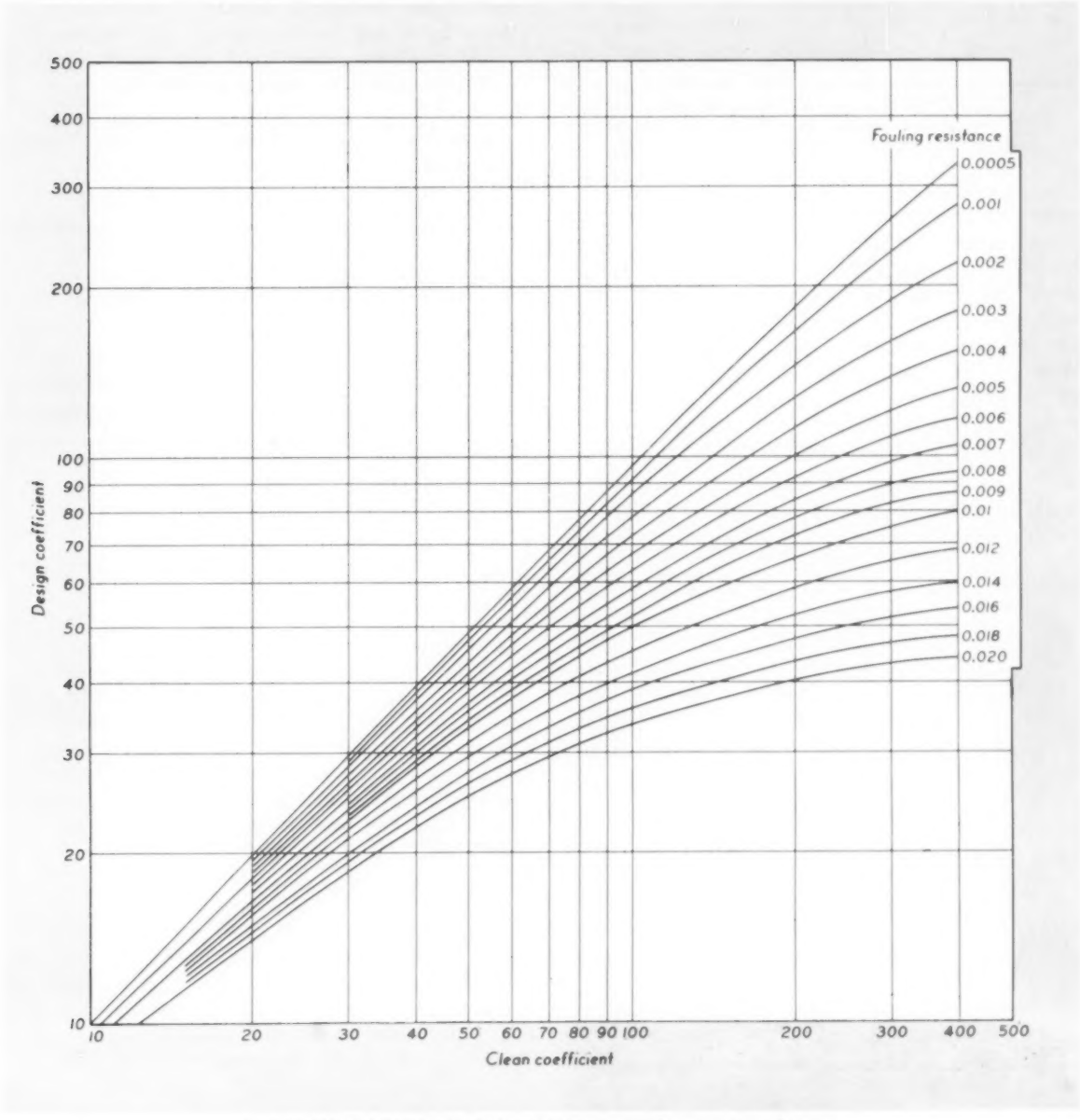
TABLE 1 — HEAT EXCHANGER UNIT

Resistance	Heat transfer resistance, percent	
	Heavy fouling	Minimum fouling
Filmwise steam, $1/h_s$	4.50	36.51
Metal, $1/h_m$	0.28	2.29
Liquid, $1/h_l$	5.30	42.94
Fouling steamside, $1/h_f$	89.85	18.26

Inspection of the above table indicates that reduction of a heavy and fouling layer on the steam side can reduce heat transfer resistance approximately 70 percent. In a system having a minimum fouled surface, the promotion of "pure" dropwise condensation can make approximately a 36 percent reduction in resistance to heat transfer. (The tubes in the heat exchanger which furnished this data were $\frac{5}{8}$ in. admiralty metal, 18 BWG.)

The promotion of dropwise condensation in a two-pass shell-and-tube heat exchanger, of 10 sq ft area, operating with 20 psi steam and minimum steam side fouling at a throughput of 32 gpm, results in a 40.3 percent increase in overall coefficient and a 35 percent increase in heat transfer. It should be borne in mind that a constant water throughput rate, increased heat transfer due to lower resistances results in some reduction of driving force $\triangle t_m$.

An example of corrosion reduction and improved heat transfer is cited in the following case history: A vegeta-



5 EFFECT OF FOULING RESISTANCE on transfer rates plotted above

ble oil extraction plant built in 1950 included rising-film evaporators and numerous heat exchangers in which tubes failed rapidly by corrosion at lower ends. After two years of service, the plant had to be shut down for complete retubing of heat exchangers (at a cost of $25,000). After retubing, flaked octadecylamine acetate treatment of steam was started at a 2 ppm dosage. In 2½ years' subsequent operation, no tube replacements have been required, measured corrosion rates have dropped to a minimum, and internal inspection shows negligible corrosion. In addition, process evaporation rate has been increased from 90 to 160 gpm through improved heat transfer, traceable to elimination of corrosion deposits and promotion of dropwise condensation on the steam side of evaporator tubes[3].

● *System B: Heating of air by steam space heaters.*

TABLE 2 — AIR HEATER SYSTEM

Resistance	Heat transfer resistance, percent	
	Heavy fouling	Minimum fouling
Filmwise steam, $1/h_s$	0.45	0.50
Metal, $1/h_m$	0.05	0.05
Airside, $1/h_a$	90.45	99.20
Fouling steamside, $1/h_f$	9.05	0.25

It is apparent from inspection of Table 2 that the only possible source of substantial heat transfer improvement in air heating systems is the reduction of a heavy fouled layer on the steam side and/or the control of the corrosion layer at a minimum by the continued use of the inhibitor. The above calculations were made on a thin walled copper alloy space heater. It is interesting to analyze the net effect of the various resistances on the overall coefficient in light of heat transfer theory. For example, in an air heater for which $h_s = 1000$ and $h_a = 5$:

$$1/U = 1/h_s + 1/h_a$$
$$1/U = 1/1000 + 1/5$$
$$U = 4.98 + \text{Btu per sq ft per hr per F.}$$

For any system in which one fixed heat transfer coefficient is very low (for example, 5 Btu per sq ft per hr per F) the maximum attainable value of U approaches the same low figure. This is to say, mathematically:

$$\text{Limit } U = 5$$
$$h_s, h_m, h_f \longrightarrow \infty$$

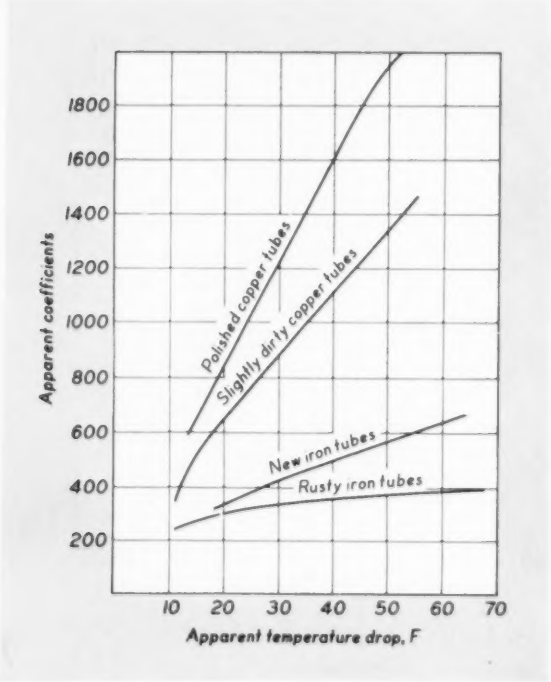
Thus, under ideal conditions, the increase possible in heat transfer by the use of inhibitors on a highly fouled air heater system is approximately 10 percent while on the slightly fouled system it is approximately 1 percent. Field tests in air heater systems under various conditions indicate that the overall increase in heat transfer obtained by filming amine treatment lies somewhere between these two values. The fouling factor is usually very appreciable in corroded iron radiators.

● *System C: Drying of material like paper by steam heated rolls.*

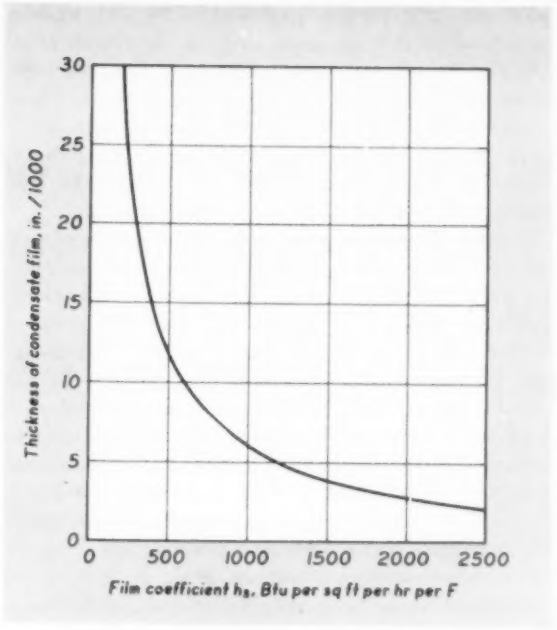
TABLE 3 — PAPER MACHINES

Resistance	Heat transfer resistance, percent			
	Wet end of machine		Drier end of machine	
	Heavy Fouling	Minimum Fouling	Heavy Fouling	Minimum Fouling
Filmwise steam, $1/h_s$	5.8	14.7	2.2	3.92
Metal, $1/h_m$	7.6	29.41	4.46	7.84
Paperside, $1/h_p$	12.56	48.54	48.89	86.28
Fouling steamside, h_f	76.04	7.23	44.45	1.96

The paper film coefficient h_p includes the resistance of the outside scale or fuzz, paper, and the air contact.



6 DIFFERENT SURFACE CONDITIONS, shown here, cause wide range of temperature drops and heat transfer coefficients



7 CALCULATED VALUE of steam coefficient for condensate film of various thicknesses is shown at right

Values of h_p used in the above calculations were 300 on the wet end of the machine and 45 on the dry end; the resistance through the metal was based on h_m of 500, corresponding to 0.6 in. thick steel wall. Table 3 shows that marked improvements in machine capacity are possible by reduction of fouling and preventing formation of new corrosion layers.

TABLE 4 — PAPER MACHINES

Resistance	Heat transfer resistance, percent: Yankee machine				Standard machine	
	Heavy fouling		Minimum fouling		Heavy fouling	Minimum fouling
Type of Roll	0.6 in. Steel	2 in. Cast iron	0.6 in. Steel	2 in. Cast iron	0.6 in. Steel	2 in. Cast iron
Filmwise, $1/h_s$	3.9	3.4	16.7	10.2	2.8	6.3
Metal, $1/h_m$	7.9	19.8	33.3	59.2	5.6	12.5
Paperside, v/h_p	9.8	8.5	41.7	25.5	35.2	78.2
Fouling steamside	78.4	68.3	8.3	5.1	56.4	3.0

Table 4 is based on actual machine design data and illustrates the extent to which heat transfer improvements are influenced by machine design. In a sulphite paper dryer in which actual sheet temperatures were measured, a value of 33 Btu per sq ft per hr per F was obtained as coefficient of heat flow between the steam and the paper sheet. The overall average for most machines is believed[21] to be well under 100. The increase in heat transfer by reduction of steam film resistance, whether by dropwise condensation or by better runoff in minimum fouled systems, would be in the range of 3 to 16 percent. Field results with filming inhibitors indicate increases in production rates range from 5 to 20 percent for various types and speeds of paper machines. The increase in drying rate of paper is linear with surface temperatures up to 212 F. Above this temperature, rate increase is somewhat less [22].

Overall heat transfer rates in existing equipment, and explanation of heat transfer improvement in such units by the use of filming corrosion inhibitors, involve numerous factors which increasingly are being recognized in the design of new heat transfer equipment. Among these factors, vapor velocities, orientation of steam paths, turbulence of condensate, rate of removal of condensate, surface conditions, etc., can all markedly affect the overall heat transfer rate. Each plant, and often identical units in the same plant, must be analyzed individually.

Fig. 5[20] illustrates the effect of total fouling resistance in reducing the design or clean coefficient of heat transfer. It is apparent that the buildup of even a thin fouling layer will produce disastrous reduction of capacity, particularly in systems designed for high overall coefficient. A fouled surface has the same effect, whether on the steam side or on the side being heated. In fact, this fouling effect on heat transfer is one of the principal reasons for eliminating scale in heat exchanges by proper water treatment, and for keeping rolls or heat transfer surfaces clean in any heat transfer system.

Don't Overlook Surface Conditions of Metals

Another factor, perhaps one of the most overlooked in heat transfer considerations, is the effect of surface conditions (smoothness or roughness) of metals. Fig. 6[20] shows the effect of the inherent character or conditions of the nonfouled materials, as well as the effect of dirt or rust on the overall coefficient U for various driving forces $\triangle t$.

It has been reported[23] that in rotary paper dryer rolls, depth of the static pond has an appreciable effect on the thickness of film around the inside of the dryer and on the steamside coefficient. A 60 in. diam roll starting with a 0.13 in. condensate pond, then rotating at normal

speed, gave a steam film coefficient, h_s, of 714, while a static pond of 0.60 in. depth dropped the coefficient to 190. Fig. 7 shows the calculated value of the steam coefficient for condensate film of various thicknesses. These calculations were based on pure condensate[25]. It is apparent that, as the thickness of the condensate film increases, it can become the controlling factor in heat transfer, independently of steam condensation rate.

In practice, one can increase the operating steam pressure in a system to increase driving force and heat transfer. This gain may be offset by design considerations, such as increasing metal thickness to withstand increased pressure. That is to say, the resistance of the additional wall thickness might compensate for any benefits expected from increase in driving force. However, whether in high or low pressure systems, keeping heat transfer surfaces smooth (eliminating pitting type corrosion) and clean (preventing fouling), and improving condensation or runoff of the steam by the use of filming inhibitors, may increase driving force and rate, without necessity for increased operating steam pressure.

An extensive research program involving laboratory, pilot plant, and field tests is now in process. This is concerned with studying the effect of filming corrosion inhibitors on heat transfer in a variety of systems. Frequent progress reports may be expected. Field investigations have shown that, in certain cases where the octadecylamine acetate has been employed, improvement in heat transfer with appreciable savings have been obtained. Pilot plant work has confirmed the improvement of the overall heat transfer coefficient by the use of long chain aliphatic amines in heat transfer apparatus.

Observations in the laboratory on the dynamics of condensate formation and layer flow indicate that filming amines cause the development of certain degrees of nonwettability of the condensing surface, and impart to such surfaces the characteristics of dropwise condensation and improved runoff of condensation.

Since the mid-'50s considerable work has been done on the stability of filming amines, on analytical methods, and on the application of these materials for corrosion control in high pressure utility systems and for improving heat transfer in process and industrial equipment, evaporators, and feedwater heaters[27–37]. In general, the filming amines have been found to be effective corrosion inhibitors in systems operating at pressures up to 2200 psi. In all pilot plant work to date, filming amines have consistently produced increased heat transfer in line with the theories presented in this article. However, field test results on heat transfer improvement with filming amines have been erratic, particularly in extreme high pressure and vacuum systems. ±

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Recommended Loudness Limits for Noise From Heating, Air Conditioning Equipment

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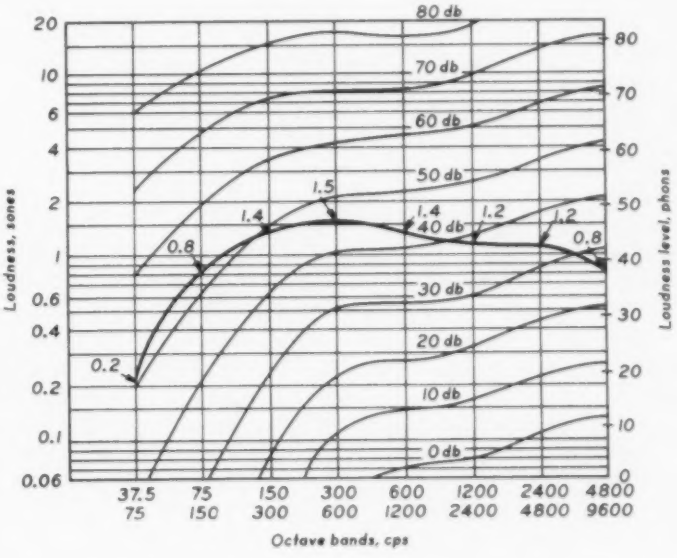
Consultants in Acoustics

MANY heating and ventilation engineers, acoustical engineers, and air conditioning equipment manufacturers are using the loudness method of computation to establish design goals for noise control of their air moving systems. After considerable study, which has been assisted and sponsored by the Barber-Colman Co., recommended loudness limits for noise from heating and air conditioning equipment in occupied areas have been worked out.

As in all environments involving human factors of this kind, it is best to prescribe a range. This has been done in Table 1, where recommended limits for *very quiet*, *quiet*, and *slightly noisy* loudness levels are listed for a variety of enclosures. The user can make his choice. It is *definitely not* recommended that lower levels than these be used. The reason for this is that, in most cases, a background noise from ventilation, if properly designed, is more pleasant than the intermittent noise from conversation, office equipment, and other acoustic effects of human occupancy. The ventilation noise serves to mask out this background sound and reduces complaints.

Fig. 1 is a loudness graph illustrating the method of plotting data and how the total loudness is computed. The noise data is first taken by getting the



1 BY FOLLOWING the six easy steps given in the text, loudness can be computed. In the example at right, for an air conditioning unit, loudnesses at all octave bands are totalled, the loudest band (1.5 in this case) being withheld until after the sum of all other bands has been multiplied by 0.3. The loudness level, found to be 3.6, can then be compared to the loudness limits for various applications given in Table 1

HPAC DATA SHEET

TABLE 1 — RECOMMENDED LOUDNESS LIMITS for noise from heating and air conditioning equipment in occupied areas are as follows

Type of area	Loudness (sones) Very quiet	Quiet	Slightly noisy
Offices			
Executive	1.5	2	3
Supervisor	1.5	3	6
General open offices	2	4	8
Tabulation and computation	3	6	12
Drafting	2	4	8
Professional offices	1.5	3	6
Conference rooms	1.0	1.7	3
Board of directors	0.8	1	2
Halls and corridors	2.5	5	10
Restaurants, cafeterias, lounges			
Restaurants	2	4	8
Cafeterias	3	6	10
Cocktail lounges	2.5	5	8
Social clubs	1	3	6
Night clubs	2.5	4	6
Banquet room (see hotels)			
Churches and schools			
Sanctuaries	1.0	1.7	3
Schools and classrooms	1.5	2.5	4
Recreation halls	2	4	8
Kitchens	4	6	8
Libraries	1.5	2.0	3
Laboratories	2	4	6
Corridors and halls	2.5	5	8
Hospitals and clinics			
Private rooms	1.0	1.7	3
Wards	1.5	2.5	4
Laboratories	2	4	6
Operating rooms	1.5	2.5	4
Lobbies and waiting rooms	2	4	6
Halls and corridors	2	4	6
Retail stores			
Supermarkets	4	7	10
Department stores (main floor)	3	6	8
Department stores (upper floors)	2	4	6
Small retail stores	3	6	8
Clothing stores	2	4	6
Hotels			
Lobbies	2	4	8
Banquet rooms	1.5	8	6
Ball rooms	1.5	3	5
Individual rooms or suites	1	2	4
Kitchens and laundries	4	7	10
Halls and corridors	2	4	6
Garages	4	6	8

Type of area	Loudness (sones) Very quiet	Quiet	Slightly noisy
Residences			
Two- and three-family units	1.5	3	6
Apartment houses	1.5	3	6
Private homes (urban)	1.5	3	6
Private homes (rural and suburban)	0.8	1.5	2
Auditoriums and music halls			
Concert and opera halls	0.8	1	1.5
Legitimate theaters	1	1.5	2
Movie theaters	1.5	2	3
Semi-outdoor amphitheaters	1.5	2	3
Lecture halls	1.5	2	3
Multi-purpose halls	1.0	1.5	2
Courtrooms	2	3	4
TV audience studios	1.5	2	3
Auditorium lobbies	3	4	6
Indoor sports activities			
Gymnasiums	2	4	6
Coliseums	2	3	4
Swimming pools	4	7	10
Bowling alleys	3	4	6
Gambling casinos	3	4	6
Transportation (rail, bus, plane)			
Waiting rooms	3	5	8
Ticket sales offices	2	4	6
Control rooms and towers	3	6	8
Lounges	3	5	8
Retail shops	4	6	8
Public buildings			
Museums	2	3	4
Planetariums	1.5	2	3
Post offices	2.5	4	6
Court houses	2.5	4	6
Public libraries	1.5	2	4
Banks (general banking areas)	2	4	6
Lobbies and corridors	2.5	4	6
Manufacturing areas			
Heavy machinery	10	25	60
Foundries	10	20	40
Light machinery	5	12	30
Assembly lines	5	12	30
Tool maintenance	4	7	10
Foreman's office	3	5	8
General storage	5	10	20
Miscellaneous			
Reception rooms	1.5	3	6
Washrooms and toilets	3	5	8
Studios for sound reproduction	0.8	1	1.5
Other studios	1.5	4	10

octave band sound pressure level by means of a sound level meter and octave band analyzer. Computing loudness from octave band sound pressure levels is straightforward. The sound level meter data in decibels should always be taken on the flat C network. The first step is to obtain the loudness of each octave band S. At least one of these bands will have the maximum loudness S_M. The total loudness is given by:

$$S_T = S_M + 0.3(\Sigma S - S_M).$$

The steps are:

1) Plot octave band data on loudness graph paper.

2) Read off loudness of each octave band in vertical columns.

3) Strike out (for the moment) the loudest band.

4) Add the loudnesses of the remaining bands.

5) Take 0.3 of this sum.

6) Add to this the maximum loudness band, the result being the total loudness.

For more information on this subject, see the HPAC Engineering Data File, *Some Noise Control Fundamentals*, published in the July issue.

LESTER T. AVERY, author of this feature, is president of Avery Engineering Co., Cleveland mechanical contractor, and a member of Heating, Piping & Air Conditioning's board of consulting and contributing editors. On this page, he reflects on his installation experiences.

Take a Good Look at Your Condenser; It May Be a Wolf in Sheep's Clothing

REFRIGERATING CONDENSERS silently, secretly, and sneakily cause more trouble with refrigerating machines and systems than they get blamed for. The past summer's hot weather —with its high wet bulb temperatures for evaporative condensers and cooling towers, and warm water in the cities' mains—has brought to light condenser weaknesses and evidence of careless maintenance that deserve our attention.

Too many people seem to think that the compressor is the heart of the refrigeration machine and that all troubles with compressors are due to the compressors themselves—for example, failures of valves, lubrication systems, pressure controls, etc. Such failures are merely external symptoms of troubles which may be caused by other parts of the system, especially the condenser.

Going back some years to the water cooled condenser of the conventional central station refrigeration type, we should be reminded that the most efficient condenser was the double pipe. Water circulated through the inner tube and hot gas condensed on the outer tube. This arrangement had true counter-current flow, whereby the hottest gas hit the hottest water and the coldest liquor was subcooled by the coldest water.

These condensers could be cleaned by removing the return bends on the water lines and cleaning with a tube cleaner. Water velocity was kept up fairly high, as the condensers were generally built in stands 10 to 12 pipes high, each 20 ft length being equivalent to one ton. Therefore 20 to 25 gpm would ordinarily be circulating through a stack. This didn't leave much chance for mud to settle out, and it was many years before these condensers scaled-up on ordinary water. Unfortunately, they were big and cumbersome, taking up too much floor space. Eventually, they gave way to the more modern, compact shell-and-tube type.

In the shell-and-tube condenser, hot gas is blown into the top of the shell and the water circulates through tubes. Some models have fins on the tubes, all of them having tube bundles in headers and flow circuits for efficient operation.

Very little counter-current arrangement is possible and very little subcooling is realized. With this arrangement, water velocity through individual tubes may be very slow. If a tube begins to foul-up from mud or scale, water flow is further restricted until finally it is stopped completely. The remaining tubes must carry the load.

Our observation has been that many of these shell-and-tube condensers operate beautifully in the spring with cold water and light loads, and reveal their deficiencies only when the maximum load is put on during the hottest part of the summer. Right then is no time to shut down.

When operated with cooling towers, this type of condenser is particularly troublesome, since the dirt which collects in the tower may settle out in the condenser. Frequently, chemicals are used to release the slime, algae, and mud from the tower itself. This material often circulates through and deposits in the condenser. This business of cleaning towers must tie in with very thorough inspection and cleaning of the condenser itself to be sure that all solids removed are actually thrown away through the drains and not left in the system.

The shell-and-tube condenser has shown further weaknesses when handling well water. As this water frequently contains sulfur and iron, high temperatures in any part of the condenser can cause quick precipitation. Well water is generally cold and therefore the rate of flow is slow compared with the higher rates used with city water or tower water. This again requires checking to be sure that some tubes are not stopped up while the rest are struggling to carry the load.

Measurement of water flow, temperature rise through the condenser, temperatures and pressures on the condenser itself, temperatures of the entering gas, and liquor leaving are all tell-tales which the experienced operator must observe if he wishes to keep the compressor in operation. Preventive maintenance is the answer and is worth doing something about before we get into another hot summer next year.

Other condenser types? We'll take a look at those in an early issue. ±

New Consumable Insert Ring Extends Use Of Inert-Gas Tungsten-Arc Pipe Welding

. . . solves bubbling, porosity problems in joining carbon steel

● While the inert-gas tungsten-arc welding process has had extensive use in joining stainless steel pipe and tubing, its application until very recently has been limited on carbon steel due to the tendency of this material toward porosity and bubbling. A major development—the silicon deoxidized consumable insert ring—has, to a large degree, solved this problem. With these rings, we can look for wide application of inert-gas tungsten-arc welding—not only in power plant piping, but in the fabrication of most piping systems involving carbon steel.

In his capacity as metallurgical engineer for Grinnell Co., Helmut Thielsch is in charge of the company's industrial piping laboratory. He is a member of various ASTM, AWS, ASME, and other technical and code-writing committees and, as such, is in close contact with the latest techniques in welding and pipe fabrication. Author of over 70 technical and research articles on welding, pipe fabrication, and metallurgical subjects, he is a frequent contributor to Heating, Piping & Air Conditioning.

BY HELMUT THIELSCH
Metallurgical Engineer
Grinnell Co., Inc.

OVER THE past several years the use of inert-gas tungsten-arc welding has increased rapidly in joining stainless steel pipe and tubing. Today, about 80 to 90 percent of all butt welds in stainless steel tubular shapes are now welded by this process.

On light wall thicknesses (up to about ¼ in.) the entire weld is generally made by inert-gas tungsten-arc welding. For thicknesses exceeding ¼ in., the usual practice consists of inert-gas tungsten-arc welding the root pass only and completing the balance of the weld by manual shielded metal-arc welding or by automatic submerged-arc or consumable metal-arc welding.

Consumable insert rings of the type illustrated in Fig. 2 are extensively used for obtaining sound crack-free root-pass welds in stainless steel tubing and piping.

On carbon steel, the application of the inert-gas tungsten-arc welding process has been only isolated. The principal objections to its use have been porosity, metal bubbling, and blow-back forming in the molten weld pool. Typical examples of bubbling in the root pass are illustrated in Fig. 3.

The amount of bubble formation tends to be less with the more highly deoxidized steel grades. For example, piping made to ASTM Specifications A-120 and A-53 generally is considerably more susceptible to bubbling than A-106 piping which is killed, i.e., fully deoxidized with aluminum and/or silicon. Nevertheless, even the fully deoxidized steel grades are liable to some bubbling, as shown in Fig. 4.

To overcome bubbling, the bevelled edges have occasionally been painted with an aluminum emulsion (usually a fine aluminum powder dispersed in a volatile carrier). During inert-gas tungsten-arc root-pass welding the aluminum melts with the steel weld puddle and deoxidizes the molten weld pool. Though the aluminum improves welding conditions and reduces the bubbling tendency, the results are nevertheless erratic, and may not prevent all of the bubbling. Moreover, excessive "alloying" of the weld pool with aluminum may have detrimental effects upon the metallurgical soundness of the root pass weld.

Some improvement is also obtained by purging the inside of the pipe with argon or helium. This consists of displacing the air on the inside of the pipe underneath the weld with argon or helium. Besides being expensive, this technique is also unreliable.

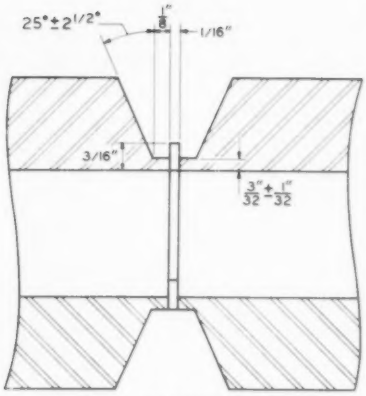
Best results producing consistently sound welds are obtained with consumable carbon steel insert rings slightly alloyed with silicon and manganese.

The composition range preferred is as follows:

TABLE 1 — EXAMPLE OF COMPOSITIONS of pipe base metal, insert ring material and weld metal in root pass of butt weld of deoxidized A-106 and not deoxidized A-53 steel pipe listed below

Base metal	Initial material	Carbon	Manganese	Silicon	Phosphorus	Sulfur	Aluminum
Silicon deoxidized A-106 pipe	Pipe	0.19	0.64	0.10	0.009	0.037	0.002
	Insert ring	0.13	0.98	0.44	0.010	0.021	0.002
	Weld metal	0.15	0.70	0.16	0.011	0.028	0.002
Not deoxidized A-53 pipe	Pipe	0.26	0.69	0.04	0.007	0.028	0.002
	Insert ring	0.13	0.98	0.44	0.010	0.021	0.002
	Weld metal	0.19	0.73	0.12	0.010	0.028	0.002

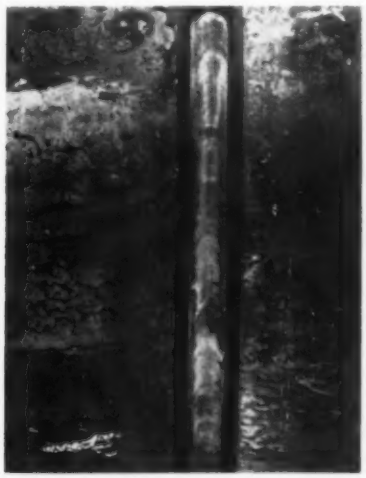
1 CONSUMABLE INSERT RING shown being placed into pipe joint preparatory to welding



2 SKETCH ILLUSTRATES eccentric location of consumable insert ring for welding in fixed (5G) pipe position

3 POROSITY, BUBBLING result in root pass of carbon steel weld made by inert-gas tungsten-arc welding

4 BUBBLING IN ROOT PASS weld made by inert-gas tungsten-arc welding in deoxidized steel shown here



5 OUTSIDE, INSIDE DIAMETERS (left and right, respectively) of root pass weld on A-53 pipe made with consumable insert ring containing 0.59 percent silicon look like this

Carbon	0.10 to 0.15
Manganese	1.00 to 1.20
Silicon	0.40 to 0.60
Phosphorus	0.01 to 0.02
Sulfur	0.015 to 0.03
Aluminum	0.001 to 0.003

Modification of these compositions as lower silicon and somewhat higher aluminum contents can provide equally as satisfactory characteristics.

In inert-gas tungsten-arc welding of the root pass with insert rings, the weld puddle consists of approximately 25 to 35 percent of molten insert ring material and the balance molten base metal. Thus, the root pass weld contains a considerably lower silicon content than the insert ring material, but a somewhat higher silicon content than the pipe base metal. For deoxidized and "not" deoxidized steel grades, this is illustrated in Table 1.

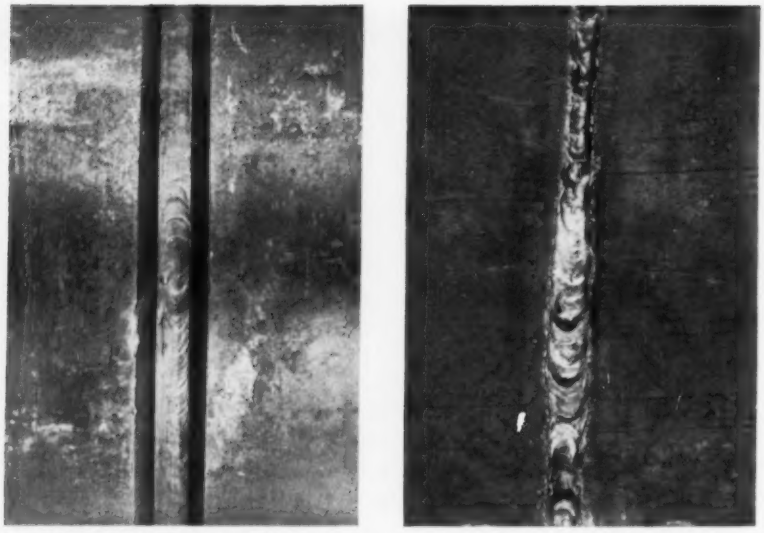
The compositions of the weld metal fall within the requirements of the applicable ASTM pipe specifications, and are sound metallurgically.

Obviously, consumable insert rings for fully deoxidized steel grades would require a somewhat lower silicon (or aluminum) content than rimmed or less deoxidized steel.

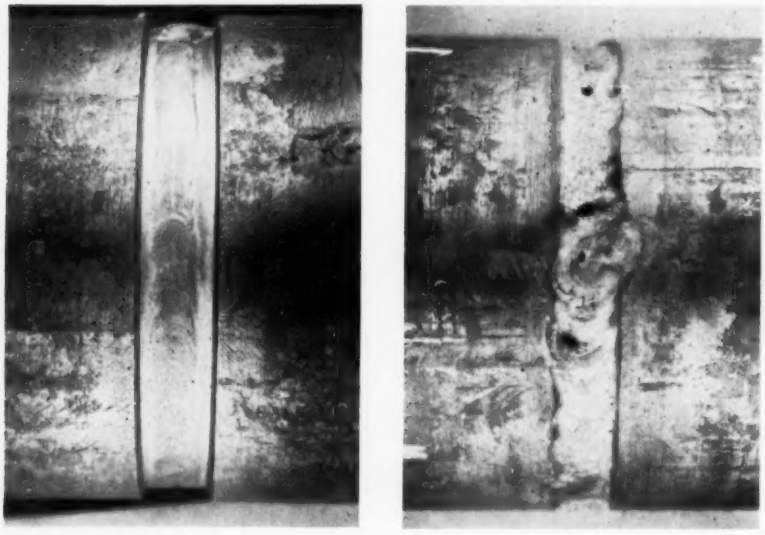
Where silicon in the consumable insert ring is the primary deoxidizer, the following minimum amounts of silicon in the insert ring are consid-

TABLE 2 — COMPOSITIONS of wrought iron base metal, insert ring material and weld metal in root pass of butt weld compared here

Initial material	Carbon	Manganese	Silicon	Phosphorus	Sulfur	Aluminum
Wrought iron	0.025	0.04	0.10	0.126	0.016	—
Insert ring	0.12	1.10	0.55	0.014	0.012	0.002
Weld metal	0.10	0.64	0.15	0.023	0.012	0.002

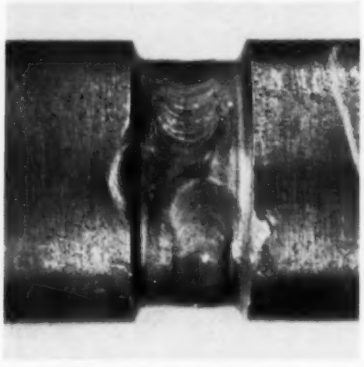


6 OUTSIDE, INSIDE DIAMETERS of root pass weld on A-106 (deoxidized) pipe made with consumable insert ring containing 0.49 percent silicon shown above

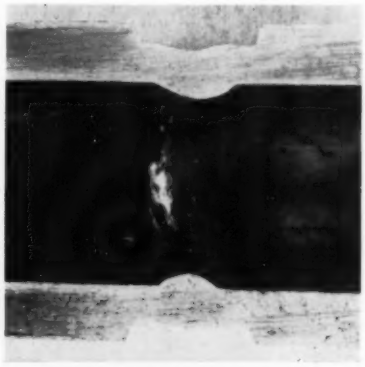


7 WELD APPEARANCE of inert-gas tungsten-arc root pass weld on wrought iron pipe welded with and without insert rings (insert ring with 0.53 percent silicon)

8 ROOT PASS weld appearance on ½ in. tubing made by inert-gas tungsten-arc welding without insert rings



9 ROOT PASS weld appearance in ½ in. tubing made by inert-gas tungsten-arc welding with consumable insert rings



10 CROSS-SECTION of weld on ½ in. tubing made with insert ring in horizontal fixed welding position

ered desirable for inert-gas welding of the root pass:

Silicon in pipe base metal, percent	Minimum silicon desired in insert ring, percent
Under 0.05	0.35
0.05 to 0.15	0.30
Over 0.15	0.20

The presence of aluminum and/or other deoxidizers in the pipe and insert ring metal may modify the values in the above tabulation.

Photographs of the root pass on the outside diameter and inside diameter sides on A-53 (not deoxidized) pipe (0.17 percent carbon, 0.02 percent silicon, and 0.002 percent aluminum) and A-106 (deoxidized) pipe (0.21 percent carbon, 0.14 percent silicon, and 0.002 percent aluminum) inert-gas tungsten-arc welded with a consumable insert ring are illustrated in Figs. 5 and 6. Purging of the pipe inside was not done.

Sound welds are readily obtained even on wrought iron pipe by inert-gas tungsten-arc root-pass welding with consumable insert rings having over 0.35 percent silicon. The surface appearances of inert-gas tungsten-arc root pass weld deposits on wrought iron made with and without insert rings are shown in Fig. 7. In Table 2, the chemical compositions of the root pass weld are compared with the wrought iron base metal and insert ring material.

Application of inert-gas tungsten-arc root-pass welding is becoming particularly desirable on small diameter tubing carrying liquids or gases at high pressures or corrosives. Present applications include small valves

TABLE 3 — COSTS ARE COMPARED for welding carbon steel piping* using three different techniques. Assume that pipe is 6 in. Schedule 40 (6.625 in. OD × 0.28 in. wall)

Technique	Labor Time				Cost				
	Setup time (including tack welding), min.	Arc time, min.	Cleaning time, min.	Repair time** (grinding and rewelding), min.	Electrode†, $	Consumable insert ring, $	Shielding and purging gas, $	Labor and overhead††, $	Total cost, $
Inert-gas tungsten-arc root-pass welding without consumable insert and without purging. Weld completed by shielded metal-arc.	8	34	6	26	0.12	—	0.20	6.18	6.50
Inert-gas tungsten-arc root-pass welding without consumable insert with purging. Weld completed by shielded metal-arc.	17	52	6	18	0.12	—	0.33	6.09	6.56
Inert-gas tungsten-arc root-pass welding with consumable insert without purging. Weld completed by shielded metal-arc.	7	28	6	5	0.12	2.00	0.20	5.67	5.99

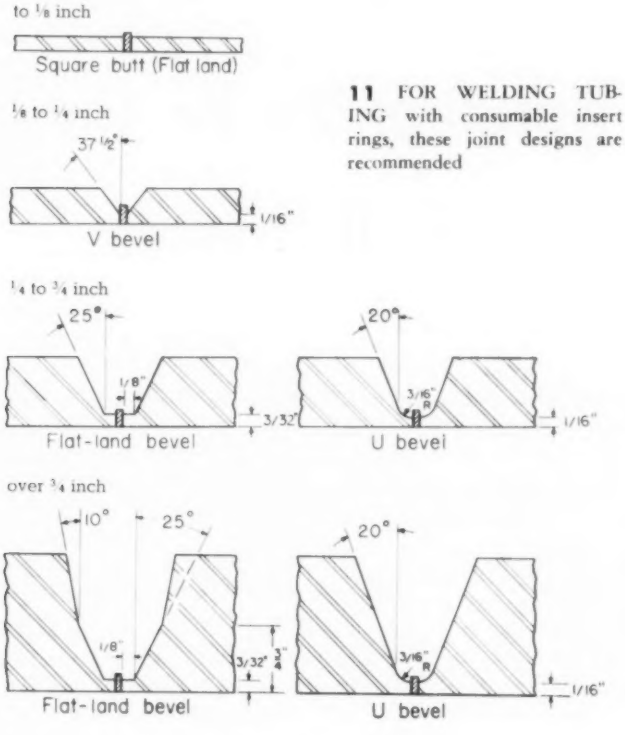
*Full penetration welds are assumed to be required.
**Based on approximately 100 production welds.
†Electrode cost $0.16 per lb.
††Labor and overhead estimated as $5.00 per hr.

for high pressure systems, exhaust systems, small diameter pressure cylinders, oil compressors, etc., involving tubing with diameters as small as ½ in. OD.

Backing rings would be undesirable or unsuitable due to the restriction offered to normal flow. To obtain full penetration and a uniform weld bead along the inside diameter by shielded metal-arc welding or oxyacetylene welding is difficult, even with experienced welders.

Inert-gas tungsten-arc welding provides the best assurance of weld uniformity and soundness. However, difficulties due to bubbling are encountered. In the small tubing sizes, therefore, the use of the silicon-modified consumable insert rings seems essential. In addition to avoiding bubbling, the insert rings assist in obtaining sound welds of uniform weld contour. Fig. 8 illustrates the appearance of ½ in. welds made by inert-gas tungsten-arc root-pass welding without insert rings. In Fig. 9 the same material has been inert-gas tungsten-arc root-pass welded with a consumable silicon-bearing steel insert ring.

A cross-section of a weld in ½ in. tubing made with an insert ring in the horizontal fixed welding position is shown in Fig. 10.



11 FOR WELDING TUBING with consumable insert rings, these joint designs are recommended

How to Prepare Bevels

Although consumable insert rings can be used satisfactorily with various major bevel preparations normally used on pipe and tube joints, the bevel end preparations illustrated in Fig. 11 are generally preferred. In particular, the "flat-land" bevel with a 3/32 in. land thickness has consistently produced very satisfactory results. Nevertheless, thinner land preparations involving 0.040 in. thicknesses and J-bevel preparations are readily welded.

The savings obtained from the use of insert rings is considerably greater than the cost of the rings. Weld repairs are extremely expensive and may amount to 5 to 20 percent of the overall welding cost. Thus, minimizing or eliminating repairs is of utmost importance. Design engineers specifying joint designs and materials should primarily specify those methods which make it as easy as possible for the welder to produce a sound weld. Otherwise, welding costs and repairs may far offset the saving gained from sound engineering design. ⧺

IMPERIAL HOUSE . . . pacesetter in apartment building air conditioning

New Apartment Building To Be Cooled By Central Fan-Coil System

BY LEWIS SMITH
Heating Engineer

THE NEW Imperial House, now under construction, is the largest apartment building to be built in New York City with air conditioning incorporated in its structure. Thirty stories high, the building has 2000 rooms and occupies a full city block.

The trend in New York City until recently has been toward the use of "through-the-wall" self-contained compressor units in each room. However, with a project the size of Imperial House, the maintenance of 1660 of these units would present a complex problem.

Hence, the owners looked with favor on a central system with fan-coil units. This solution agreed with a cost analysis made by the consulting engineers on similar buildings in which a seven-year life for the "through-the-wall" units and a 20-year life for the central system was assumed. The analysis indicated that the central system would be more economical.

Cool Exterior Zones Only

With no interior spaces requiring cooling to make them comfortable, it was not considered vital to provide standby service. Hence, a single 940

● The trend in new apartment building is toward including air conditioning as an essential building service right at the construction stage—especially in New York City, where 96 percent of all new apartment structures this year are being cooled (see August, page 44). The 30-story Imperial House, largest apartment building to be built in New York with air conditioning incorporated in its structure, will have its exterior areas cooled by fan-coil units supplied by a single 940 ton centrifugal compressor. Heating requirements will be met by a two-zone (north and south) system which will use hot water as the heating medium.

Mr. Smith, a frequent contributor to Heating, Piping & Air Conditioning, has had many years' experience in heating and air conditioning large buildings. He is responsible for the development of heating systems which have been adopted by many apartment house projects in New York City and elsewhere.

ton centrifugal compressor, driven by an 850 hp motor, was selected. To keep the compressor from shutting down too often at light loads, the cooling tower fans are cycled under control of a condenser water thermostat to maintain a high water temperature.

To insure maximum quietness, the fan-coil units were selected to provide the required capacity for average conditions when operating on the intermediate speed of the three-speed motors. Manual switches permit the tenants to select the speed for their own comfort.

In winter, the low speed will provide ample heating capacity, so the tenant can control his own temperatures the year 'round. The cooling capacity of these units operating at top speed for the living rooms is 11,500 Btu per hr at 400 cfm. Bedroom units have a cooling capacity of 8300 Btu per hr at 300 cfm. An outdoor air inlet is provided through the wall at each unit with a manual damper.

Bathrooms are on the interior, ventilated through an exhaust duct system with roof fans, and heated with 750 watt electric heaters to be used as desired. These heaters are on the tenant's meter. Kitchens, which are on the outside, have steam convectors on a separate steam system with no provision for cooling.

Steam Supplies Zone Converters

Four steam boilers supply heating, each with a rated capacity of 45,000 sq ft EDR. One of these serves as a reserve.

The heating system is divided into two zones, north and south. A hot water converter is provided for each zone which is large enough to serve the entire building heating load in an emergency. Water temperature during the heating cycle is controlled by two valves in parallel to each converter, operated in sequence from an outside thermostat and the water temperature.

The 380 apartment units not only have exceptionally large rooms, but also have large numbers of rooms — from four to eight per apartment. The building's first floor is given over to a lobby, retail stores, and professional offices. Above are 27 floors of apartments and two utility floors.

The lobby has its own 20 ton packaged cooling unit. Condenser cooling water will be supplied to the shops on the first floor for whatever cooling equipment may be installed by the tenant. This water is to be handled on a separate circuit with its own pump because of the different hours and days of use.

The heating and air conditioning systems were designed by Cosentini Associates, consulting engineers, and are being installed by the Raisler Corp., mechanical (heating, piping, and air conditioning) contractors. ≠

the law and your profits

JOHN F. MORRISSEY, author of this regular feature, is an attorney at law and has an extensive practical business and legal background. This series is based on actual cases. All names are, however, fictitious. It should, of course, be remembered that the law varies in different states.

Dangers of Faulty Installation Broaden Contractor's Obligations

WHAT DUTIES and obligations does a contractor owe with regard to his workmanship to persons not parties to a contract? The following case illustrates a rule and an exception in answer to this question.

Marshall Frame had leased a bowling alley from Morr Building Corp. Shortly after taking possession of the premises, Frame ordered a large heating unit from the O. Verr Heating Co. Without the consent of the Morr Building Corp., the unit was installed on the premises and paid for by Frame.

On a cold night two weeks later, a part of the building near the heating plant became ignited and the building was substantially damaged by fire. Morr, the property owner, filed suit against both Frame and O. Verr Heating.

The complaint charged that the unit had been negligently installed and, among other acts of carelessness, that it was not placed on a foundation of brick or stone and that certain wooden parts of the building were not protected as was required by ordinances then in effect.

The trial court dismissed the case against Frame, the tenant, but found O. Verr Heating guilty and awarded damages to Morr.

O. Verr appealed the case to a higher court and argued that Morr had failed to present a valid case against the heating company. O. Verr told the court that it is a general and widely accepted rule of law that, where an independent contractor is employed to construct or install any given work or instrumentality, and has done so to the acceptance of the employing party, he is no longer liable to third persons for injuries received as a result of defective construction or installation.

"Frame," said O. Verr, "may be liable to Morr, as there was a contractual relationship between them. But we had no contract with nor any obligation to Morr."

It is true, the higher court said, that where a charge of negligence is based upon a breach of duty arising out of contractual relations, no cause of action arises in favor of one not a party to the contract. But, said the court, there are exceptions to this rule.

An exception, cited by the court, will arise where one has, by sale or otherwise, put into circulation some imminently dangerous thing which is likely to cause injury to a third person or destruction to his property.

This exception applies not only to sales but to the construction of structures imminently dangerous to life or property. There can be no question of liability on the part of a contractor if he has knowledge of a defect in the structure.

But knowledge of a defect on the part of a contractor is not essential to the exception. Negligence on his part is sufficient to sustain liability. A contractor continues liable where work is turned over by him in a manner so negligently defective as to be dangerous to third persons.

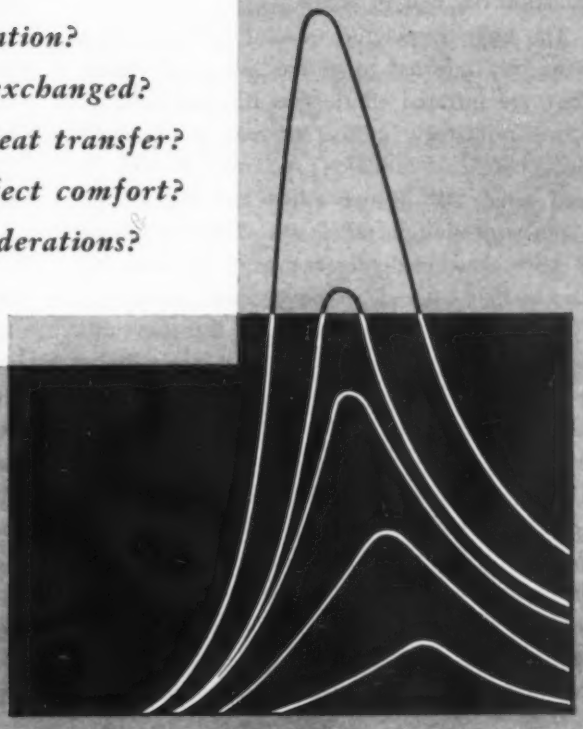
The higher court held that there was sufficient evidence before the trial court to justify a finding that O. Verr Heating's negligence caused the fire. In upholding the finding of "guilty" against O. Verr, the court declared that a heating plant may be a dangerous instrumentality if not properly installed, and the care of installation should be commensurate with the danger to persons or property.

It can be seen in this case that, although a contractor generally has no obligations with reference to his work to persons not parties to the contract, there is an exception in the case of resulting injury or destruction which is almost as broad as the rule itself. ∔

HPAC ENGINEERING DATA FILE

High Intensity Infrared Radiant Heating

- *What is infrared radiation?*
- *How is radiant heat exchanged?*
- *What affects radiant heat transfer?*
- *How does radiation affect comfort?*
- *What are design considerations?*



What to Consider When Using Infrared Radiant Heaters for Comfort Heating Applications

HIGH INTENSITY or high temperature radiant heaters are finding acceptance in many industrial and commercial comfort heating applications. This method of heating has been used for many years for industrial process heating in bake ovens, dryers, etc. In contrast with the conventional low temperature radiant heating panels, which often require utilization of the full floor or ceiling area to obtain sufficient heating capacity, the high intensity units are of relatively small area as they emit a much greater quantity of thermal radiation per unit of area.

The high temperature radiant heating unit is frequently referred to as an "infrared" heater. They are infrared emitters as thermal radiation occurs principally in the infrared band of the electromagnetic radiation spectrum as will be seen later. All heated solids and liquids and some gases emit infrared rays. Thus, it follows that we are considering energy of the same nature as that emitted by conventional ceiling and floor panel heating systems except that it is introduced into the heated space at a much higher intensity. Because of the difference in intensity, some differences in application must be considered.

Some of the specific applications in which these heating elements are being used for comfort heating include spot heating in warehouses and industrial shops; heating outdoor loading docks and stadium grandstands where the use of conventional heating systems is not practical; heating high bay areas in which stratification with conventional systems may be a problem, areas adjacent to large glass exposures to offset radiant losses to the cold glass surfaces, and spaces with high periodic infiltration loads; and in many cases, they are used in ordinary industrial heating applications for which convection systems are most commonly used. In the latter application, the heaters warm both the human bodies and the floor surface by direct radiant heat exchange. In this application they serve essentially the same function as the embedded piping in the conventional hot water panel heating system since they are the source of energy for the floor panel which re-radiates and transfers heat by convection to the heated space. They are perhaps better suited for some applications than others. The only limit to their application is fitting their heating characteristics to the needs of a particular space.

Almost every source of energy is used in high intensity radiant heating units. Some are direct-fired and several means are used to convert the major portion of the energy in the flame to radiant energy. In some, the exterior surface of the combustion chamber is exposed to permit radiant heat transfer. In others, the fuel is burned on the surface of a suitable ceramic element which becomes the emitter of thermal radiation. The fuel in direct-fired units is generally gas. Coal and oil could be used with units properly designed for these fuels. However, the fuel and ash handling problem with coal would have to be solved. The salamander, which burns wood or

High intensity or "infrared" radiant heaters are being used more frequently in industrial and commercial comfort heating applications. In addition to their use for heating areas that cannot practically be heated by systems delivering the greater part of their heat by convection, they are being used in applications for which conventional hot water and warm air systems are normally used.

In this report, the fundamentals of radiant heat transfer are presented with emphasis on their application to space heating applications. How to calculate radiant heat exchange, how radiant heating affects comfort sensations, and what to consider when selecting and locating the radiant heating unit are some of the topics covered. While the energy involved in this type of heating is the same in nature as that emitted by conventional hot water radiant panels, it is introduced into the space at a much higher intensity and some differences in application must be considered to provide acceptable comfort levels.

coal, is the forerunner of the present day infrared heater. Electric bulbs especially designed for this purpose are also used for radiant heating. These bulbs have long been used for process heating and heat therapy and have only recently been applied for comfort heating.

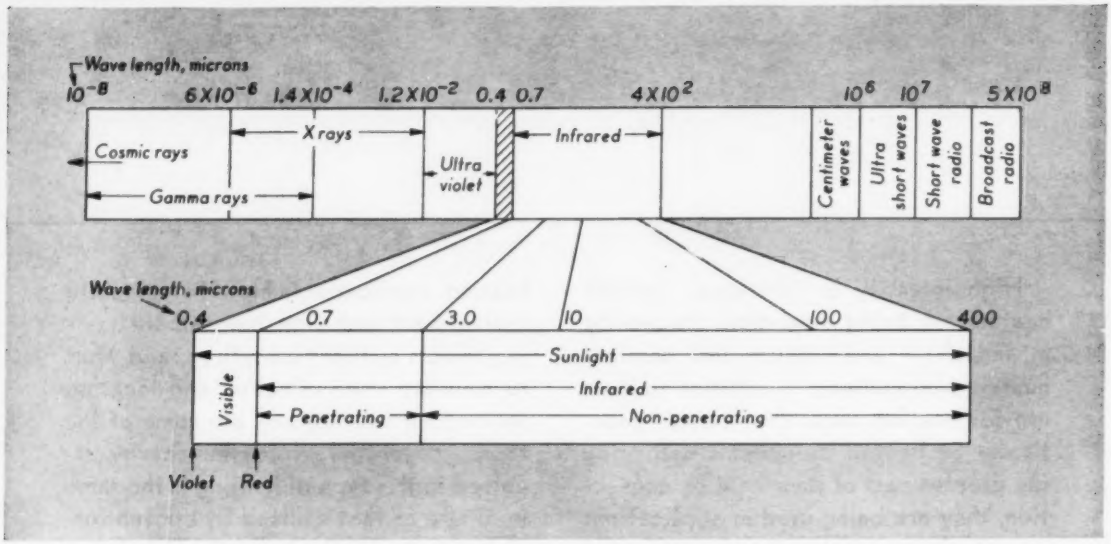
In this report, the fundamentals of radiant heat transfer are presented with emphasis on application of the high intensity radiant heaters to space heating and what must be considered when designing for their use. A review of the effects of thermal radiation on comfort sensations is also given and some simple rules of application based upon the information presented are included.

Thermal Radiation — Its Nature and Exchange

Thermal radiation is defined as the radiant energy emitted by a heated surface which depends *solely* upon the temperature of the body. Thermal radiation waves are similar in nature to other electromagnetic rays and differ from the very short cosmic rays and the very long waves of the radio broadcast band only in wave length. All of these waves travel at the speed of light. Thermal radiation comprises electromagnetic rays of wave lengths ranging from 0.3 microns (0.0000394 in.) to 400 microns. The electromagnetic spectrum and the thermal radiation portion of the spectrum are shown in Fig. 1.

While all waves of the spectrum are of the same nature, their effects on bodies vary with the bodies' ability to absorb, reflect, and transmit the incident waves. For example, X-rays are transmitted in varying degrees by the tissue and bones of the body. Broadcast band waves are virtually all transmitted with no known effect on the body. Visible and infrared waves are absorbed within a very short distance of the skin surface or any other absorbing surface and, upon absorption, produce warming of the body.

Thermal radiation includes visible and infrared rays and to a limited extent ultraviolet waves. The eye can perceive radiation in the very limited range of wave lengths of about 0.4 to 0.7 microns. Infrared radiation comprises rays with wave lengths from 0.7 to 100 microns and more. The infrared band — the band of interest insofar as thermal radiation is concerned — is sometimes



1 THERMAL RADIATION, which includes both visible and infrared waves, is but a part of the spectrum of the family of electromagnetic waves. The quantity and quality of thermal radiation depends solely upon the temperature of the surface emitting the radiation. All electromagnetic waves are transmitted at the speed of light. All heated solids and liquids, and some gases emit thermal radiation. Conversely, these materials absorb a part of the visible and infrared waves and convert them to heat. At surface temperatures greater than 1000 F, a part of the radiation is visible

further subdivided into regions. The penetrating band — 0.7 to 3.0 microns — is also called the near infrared region because of its proximity to the wave length which is perceived by the eye as the color red. The non-penetrating band — 3.0 microns and up — is also called the far infrared region. These designations have significance in engineering design only as an indication of the quality of radiation. Conventional heating panels emit their radiant energy in the far infrared region. High intensity units emit some energy in the near region — the amount emitted in this region depends upon the heating element temperature — and some in the visible region when the emission temperature is greater than 1000 F.

Absorptivity and Emissivity

A body that will absorb all of the incident thermal radiation is defined as a *black body*. This term arises from analogy with the visually black surface that absorbs all incident light waves. However, in thermal radiation the observed color of the body has little relationship with its ability to absorb radiation. For example, snow absorbs 98.5 percent of the incident radiation emitted at normal temperatures while soot absorbs only 95 percent of similar radiation.

There is in nature no truly black body for thermal radiation, however, the black body concept is useful in comparing the absorption of radiant energy by different materials. *Absorptivity* is defined as the ratio of radiant energy absorbed by an actual surface at a given temperature to that absorbed by a black body at the same temperature.

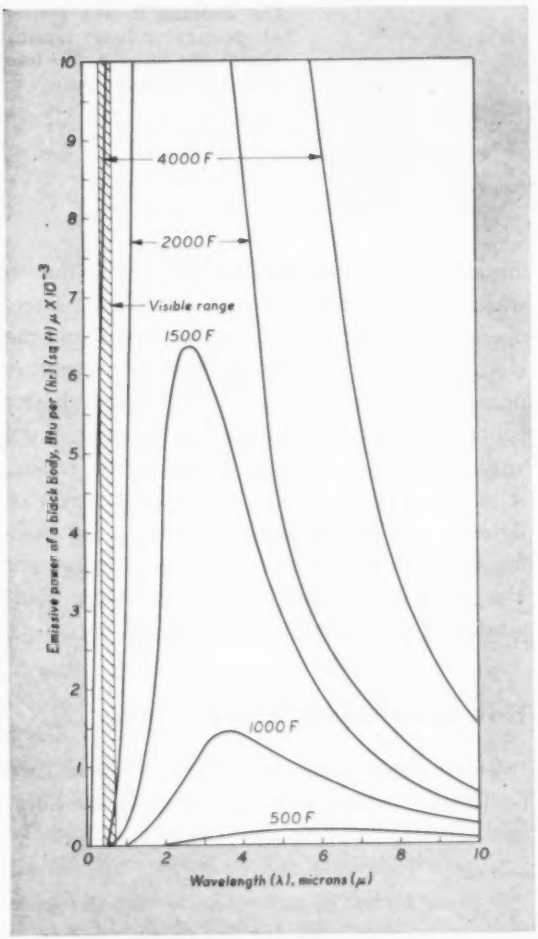
Solids and liquids absorb practically all of the thermal radiation penetrating the surface[1] within a very thin layer. Electric conductors need a layer about 0.00004 in. thick for absorption. Electric nonconductors, in general, require a layer of about 0.05 in. for complete absorption of the penetrating radiation. Glass is an exception to this latter rule because a large percentage of the incident radiation is transmitted. In general, for most engineering materials no radiation is transmitted since absorption takes place in such a short thickness. The radiation which is not absorbed is reflected by the body to the surroundings. For all materials, except those that transmit radiation, the sum of the absorptivity and the reflectivity of the surface is equal to one.

While a black body absorbs all incident radiation, it also emits radiation. A black body emits the maximum amount of thermal energy at any temperature. The radiation emitted by any other kind of surface at the same temperature will be less. The *emissivity* of a surface is the ratio of the

[1]*Numerals refer to references listed on page 154.*

energy it emits to that emitted by a black body at the same temperature. Emissivities of materials common in space heating applications are listed in Table 1. The emissivity of most materials increases with an increase in the temperature of the material.

Absorptivity and emissivity are approximately equal for most materials at the temperatures encountered in practice. However, absorptivity depends upon the quality of the incident radiation as well as surface temperature. If the incident radiation is from a high temperature source, such as the sun, the emissivity and absorptivity may differ markedly. For example, the absorptivity of white paper at normal temperatures is 0.96 whereas the absorptivity decreases to about 0.2 for solar radiation. The effect of the temperature of the source of radiant energy on absorptivity is given in Reference 1 for several common engineering materials.



2 THE EMISSIVE POWER or radiant energy generated at any wave length by a "black body" — the most efficient surface emitting thermal radiation — is shown here as a function of the temperature of the surface. As the temperature of the surface increases, the emissive power increases and the wave length at which the maximum radiation occurs decreases. The total radiation emitted at any given temperature is equal to the area under the curve for that temperature. An actual heater surface will emit less radiation than a black body at any given temperature

Radiation from a Heated Surface

The emissive power of a black body at any given wave length can be computed[2] by Planck's law of radiation. The emissive power of a black body is plotted as a function of wave length in Fig. 2 for various surface temperatures. As the temperature of the black surface is increased, the maximum radiation occurs at shorter wave lengths and has a much higher intensity. Also, an increasingly larger portion of the radiation occurs in the visible range.

The wave length of maximum emissive power, the maximum intensity, and the total emissive power for black bodies are given in Table 2. The wave length at which the maximum occurs is found[1] from Wien's displacement law. The product of the wave length at maximum intensity and the absolute temperature of the surface [degree

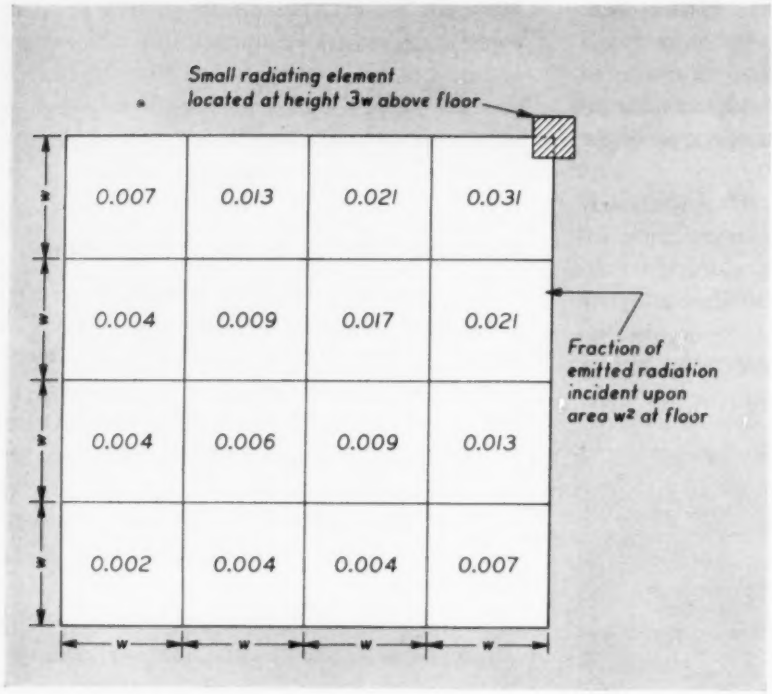
Table 1 — EMISSIVITIES of some materials commonly encountered in space heating are given here

Surface	Surface temperature, F	Emissivity
Clothed body	Room	1.0
Asbestos board	74	0.96
Brick	70	0.93
Aluminum paints: 10 percent Al, 22 percent lacquer	212	0.52
26 percent Al, 27 percent lacquer	212	0.3
Oil paints	212	0.92 to 0.96
Glass, smooth	72	0.937

From Heat Transmission, *W. H. McAdams, McGraw-Hill Book Co., Inc.*

Table 2 — WAVE LENGTH at which a "black body" emits its maximum radiation depends upon its temperature as shown here. The maximum radiation at this wave length and the total emissive power are also given

Temperature, F	Temperature, R	Wave length of max radiation, microns	Maximum intensity of radiation, Btu per hr per sq ft per micron	Total emissive power, Btu per hr per sq ft
150	610	8.56	18	239
500	960	5.44	177	1,465
1000	1460	3.58	1,440	10,200
1500	1960	2.66	6,350	25,500
2000	2460	2.12	19,700	63,300
4000	4460	1.17	383,000	692,000



3 CONFIGURATION FACTOR of small areas on floor with respect to small radiating panel in ceiling indicate fraction of radiation emitted by heater that will be received by a small area of the floor. Radiation is emitted hemispherically from the surface, with the maximum emitted perpendicular to the surface. As distance between heater and elemental area of floor increase, the radiation received by the floor decreases. For geometry shown, the fraction decreases from 3 percent of heater's radiant capacity beneath the heater to less than 1 percent at the perimeter

Rankine (R) = deg F + 460] equals the constant 5216 microns (R). The maximum intensities at two temperatures are in the ratio of the fifth power of the absolute temperatures.

The total emissive power of the black surface is found as the area under the curves of Fig. 2. This quantity is of most interest and usefulness in design and is obtained from the Stefan-Boltzmann equation for total emissive power of a black body which is:

$$E_b = \sigma T^4$$

where:

E_b = Black body emissive power, Btu per hr per sq ft per micron

σ = Stefan-Boltzmann constant 0.1713×10^{-8} Btu per hr per sq ft per R^4

T = absolute temperature of surface, R

From the above, the ratio of the total emissive power of a black surface at two different temperatures is proportional to the ratio of the fourth powers of the absolute temperatures.

For the actual surface, the emissive power is found by the relationship:

$$E_a = \sigma e_a T_a^4$$

where:

e_a = emissivity of the actual surface

From this it is evident that the quality and quantity of radiation emitted per unit area by a radiant heater vary with the material of which the radiating element is constructed and the temperature to which it is heated. Direct-fired gas radiant heaters operate in the range from 750 to 1600 F and the electric bulb operates with a filament temperature near 4000 F. It follows that the electric heater emits a considerable portion of its radiation in the visible and near infrared regions. For this reason, it can be designed to serve the dual function of lighting and heating during periods when heating is required. The higher temperature gas unit also emits in the visible range but only a small portion of its energy is emitted in this region.

How to Calculate Heat Exchange

The radiant heat transmission between two bodies may be determined from the relationship:

$$q = \sigma F_e F_{12} A_1 (T_1^4 - T_2^4)$$

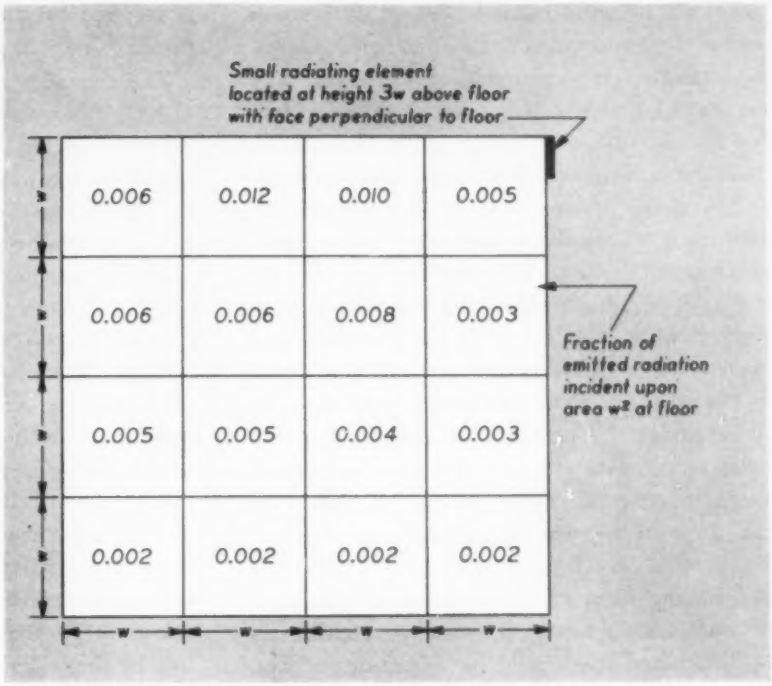
where:

q = the net rate of radiant heat transfer, Btu per hr

F_e = the interchange factor, a dimensionless factor which takes into account the emissivity of the surfaces involved in radiant heat exchange and the reflections and re-radiations between surfaces

F_{12} = the configuration factor, a dimensionless factor expressing the fraction of radiation emitted by surface A_1 that is received by surface A_2

T = absolute temperature of the surfaces, R



4 CONFIGURATION FACTOR of a small area on floor with respect to a vertical radiating surface is shown here. With vertical surface, maximum radiation is received by floor surface at some distance from heater (approximately 2 w) along line perpendicular to center of surface. Variation over area indicates need for carefully considering location of units to provide uniform heating of the floor surface

Interchange Factors

The interchange factor or emissivity factor in the radiant heat exchange equation takes into account the effect that the emissivity of the radiating bodies have on the energy transfer. When the radiating bodies are black, this factor is one. For actual surfaces, the interchange factor is less than one and depends upon the emissivity and the shapes involved in the radiation transfer.

When the emissivity, and therefore the absorptivity, is less than one, a portion of the incident radiation is absorbed by the surface and a portion reflected. The reflected rays in turn strike a second surface with a part being reflected and a part absorbed. These reflections continue until all of the radiation is absorbed. In the actual case, a portion of the radiation emitted by a heater is absorbed and reflected by each body upon which its radiation falls or by each body that can "see" the heater. Thus, the human body, the primary target for the radiation, receives both direct waves from the heater and reflected waves from the floor, tools when present, etc. In practice, one may neglect reflection without introducing serious error if the absorptivity of the surfaces relevant to the problem is 0.85 or larger.

Interchange factors for some common heat exchange surfaces have been evaluated. Some of those of interest in infrared heating are as follows:

1) For radiant interchange between two bodies which are small as compared to the distance between them[1]:

$$F_e = e_1 e_2$$

or, the product of the emissivities of the two bodies. This factor is applicable to the radiation transfer between a radiant heater and the human body. When the emissivities of the enclosing surfaces exceed 0.93, this factor may also be used with reasonable accuracy[3] to determine the gross heat transfer between large panels.

2) For radiant interchange between a small surface and a large enclosure[1]:

$$F_e = e_1$$

where e_1 is the emissivity of the small surface. This factor is applicable to the interchange between the human body and an enclosure — the walls, glass areas, and ceiling. It also applies for radiant exchange between the heater and the enclosing surfaces.

Configuration Factors

The configuration factor in the heat exchange equation takes into account the affect of shape and relative positions of the radiating surfaces on the radiant heat exchange. A heater emits the

maximum intensity of radiation in a direction normal to its surface. For emission at other angles, the intensity varies approximately as the cosine of the angle between a perpendicular to the surface and the direction in which the radiation is emitted. Also, the radiation received by a surface varies inversely as the square of the distance between the emitting body and the receiver when each is small as compared to the distance between them. Hence, if 1 unit of radiation is received by body A from body B when they are 10 ft apart, 4 units will be received by A when they are only 5 ft apart.

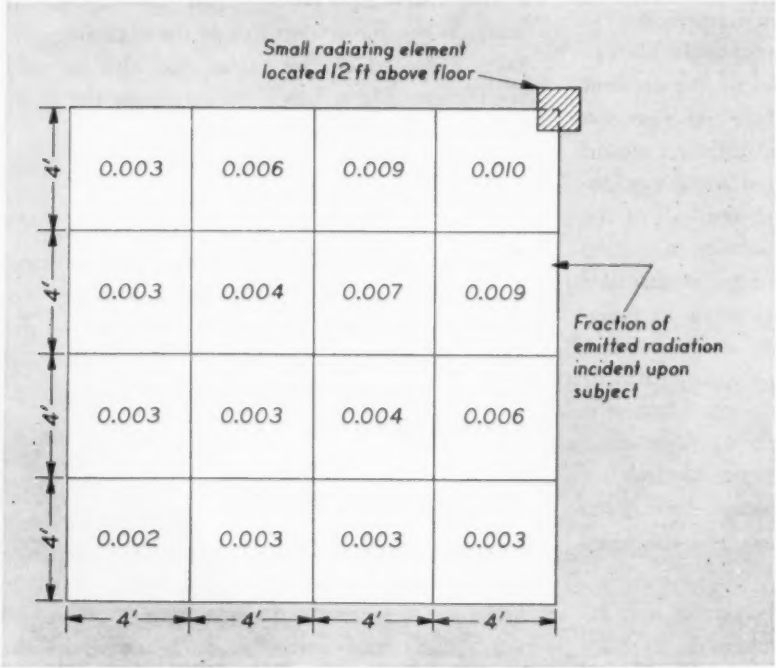
The effects of these two factors related to the geometry of the problem are combined in the configuration factor. The symbol F_{12} is interpreted as the fraction of energy emitted by surface A_1 that is received by surface A_2. It can be shown that $F_{12} A_1 = F_{21} A_2$. This is a useful relationship when determining factors for complex surfaces.

Configuration factors for some geometries can be determined analytically, but for many surfaces, a graphical or mechanical integration process is necessary. The latter process is described in a number of references[1,2,3,4].

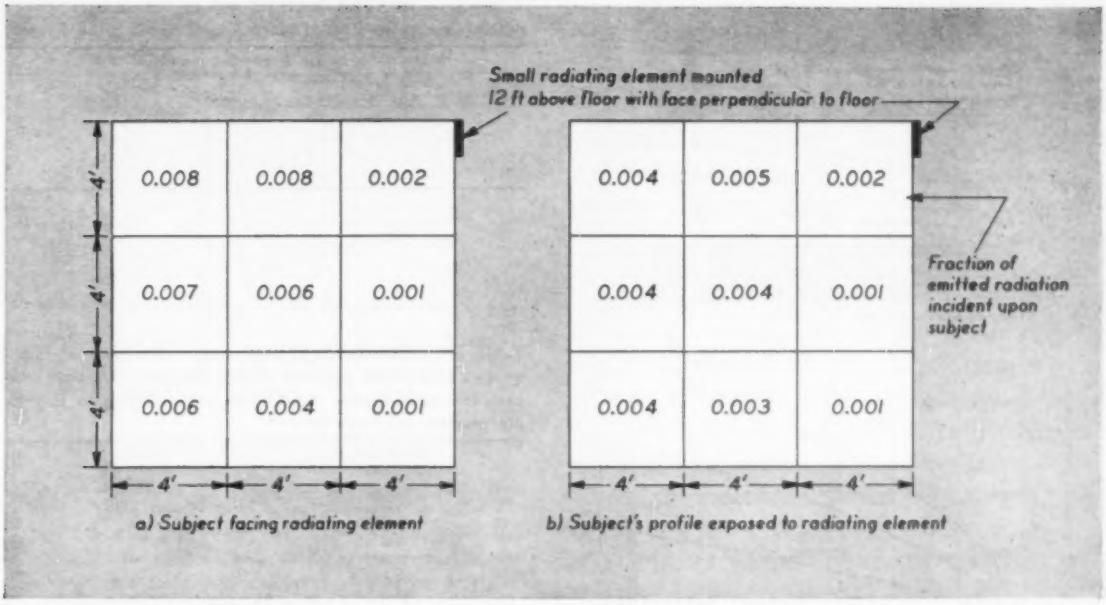
Configuration factors have been evaluated for a number of shapes and surface relationships commonly found in practice. Using these data it is possible to determine the fraction of the radiation emitted by a small infrared heating element that is received by the human body[4] and by planes parallel[2] or perpendicular[5] to the heater surface.

The configuration factors for a small element of heater surface with respect to a parallel surface are given in Fig. 3. The area shown is only one fourth of the total area irradiated by the heater. The factors for squares with sides of length w in the other quadrants can be found by symmetry. It will be observed that the radiation received by elements of area $w \times w$ on the floor (when the radiating surface is mounted in the ceiling) diminishes as the distance between the heater and the area increases. To achieve uniform heating of the floor, the heaters must be spaced so that the radiation received from all heaters that can be "seen" will be a constant for each element of floor area. Furthermore, with fixed heater capacity the spacing and mounting height must be varied to obtain the desired quantity of incident radiation. The latter will be influenced considerably by the radiation that can be tolerated by the individual in direct radiant heating applications, and by the heat loss of the space when heating an entire building.

In Fig. 3, the mounting height is given as three times the length of the side of an elemental area on the floor. As the mounting height increases, the area of the floor receiving the indicated fraction of radiation also increases as the square of w.



5 CONFIGURATION FACTORS for a man standing at the center of each square, show that subject receives less radiation than floor surface. These values apply to a subject standing with a semi-profile exposed to heater, or seated with front semi-profile exposed. Compare with Fig. 3 and note that at perimeter positions subject receives about the same radiation as the elemental area of the floor



6 CONFIGURATION FACTORS for standing man with respect to a small wall panel are shown for two exposures of the subject. Compare with Fig. 5 and note that subject receives a smaller percentage of the radiation emitted from a vertical panel at the same mounting height and that the maximum occurs at distance of about 2 w for case shown. Beneath heater, radiation received by subject is less than 0.2 percent of that emitted by heater

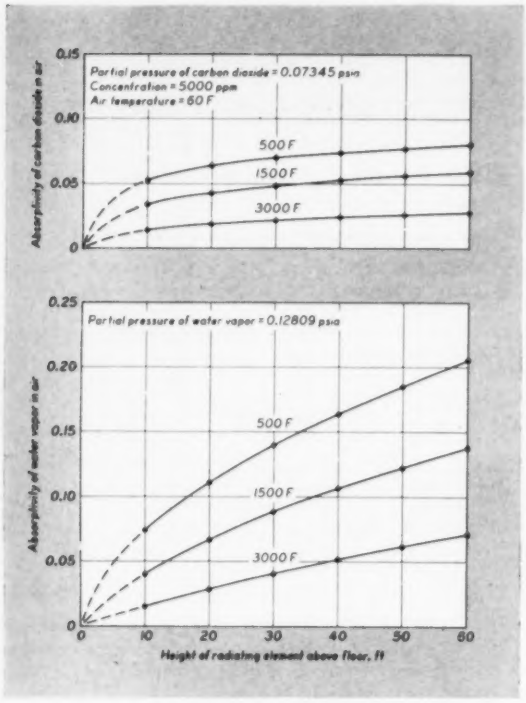
Thus, the radiation received per sq ft of floor decreases as would be anticipated from the square of the distance law. With mounting heights greater than 30 ft, the elemental area on the floor becomes too large to predict the uniformity of radiation with any degree of accuracy. The elemental area for a 30 ft mounting height would be 100 sq ft. For greater mounting heights, new factors should be evaluated using available data. This is done by determining the factor for the element of area beneath the heater and then repeating the process for successively larger numbers of squares of the same size. The sum of the factors for two squares is equivalent to the factor for a rectangle with dimensions $w \times 2w$.

The effect of spacing on the radiation received by an element of floor area $w \times w$ can be found by summing up the radiation received by the area from each heater that the area "sees". For the geometry of Fig. 3 and assuming that all heaters have equal capacity, the radiation received by each area on the floor for spacings w, $2w$, $3w$, and $4w$ is approximately 69, 17, 8, and 4 percent, respectively, of that emitted by one heater. The radiation received varies about as the square of the ratio of the spacing of the radiating elements. That is, at a spacing of $2w$, the radiation received is one-fourth that with a spacing of w.

Fig. 4 gives factors for elemental floor areas when the radiating surface is perpendicular to the floor. This can be used to determine the factors for the radiation from a ceiling panel to a wall surface when this is needed. Conversely, Fig. 3 can be used to determine the factor for radiation from a heater perpendicular to the floor to a nearby wall. It will be noted in Fig. 4 that a radiating surface located high in an outside wall will warm the perimeter of the floor to a very limited extent as less than ½ percent of the heater's radiant capacity will be received by an elemental area.

The configuration factor for the human body located at the center of the element of floor area with specific orientations to the heating surface are given in Figs. 5 and 6. These values were measured[4] by mechanical means using a dummy approximating a 165 lb, 5 ft 10 in. man as the subject. Factors for other orientations of the body and for other distances between the radiating surfaces of an enclosure are given in Reference 4. These will be useful when determining the location of radiant heating elements for spot heating.

The variation in uniformity of irradiation of the individual is similar to that for the floor surface. However, the body receives about 1/3 as much radiation as the elemental floor area near the heater, and about the same amount at remote lo-



7 WATER VAPOR and carbon dioxide are two gases commonly present in industrial atmospheres that absorb radiation. Since radiation is absorbed progressively as it travels through the gas and selectively in various wave length bands, the absorptivity depends upon the temperature of the emitting surface, the distance the radiation travels before striking the object to be heated, and the concentration of the gas in the atmosphere. Absorptivity of these two gases is shown here for specific concentrations of each gas and several heater mounting heights and surface temperatures

cations. When direct radiant heat transfer is depended upon for comfort, the radiation received by the subject is most important. The locations of the heating elements for spot heating should be selected with this in mind.

The configuration factors for the body with respect to a heating surface perpendicular to the floor are given in Fig. 6. The maximum radiation received in this case occurs near the center of the total area shown. The effect of the change of angle between the heater and the body as one moves away from the surface is greater than the effect of the change in distance. It will be noted that the body receives a maximum amount of radiation when located about 8 ft from the radiating surface and on the normal to the surface. As distance is increased beyond this point, the radiation received decreases. Although configuration factors are not available for an inclined surface, the factor would be some value between those given in Figs. 5 and 6 with the maximum value occurring closer to the surface of the heater than it does for the conditions of Fig. 6.

Table 3 — WATER VAPOR and carbon dioxide absorb radiant energy in limited wave length bands given here

Water vapor		Carbon dioxide	
Band no	Wave length range, microns	Band no	Wave length range, microns
1	1.7 to 2.0	1	2.4 to 3.0
2	2.2 to 3.0	2	4.0 to 4.8
3	4.8 to 8.5	3	13.5 to 16.5
4	12.0 to 30.0		

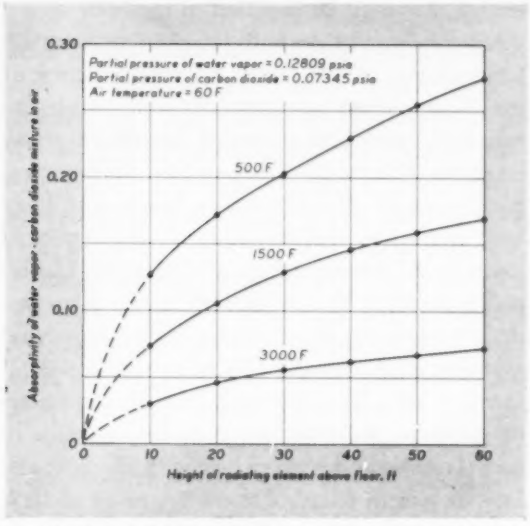
Table 4 — ABSORPTIVITY of water vapor given in Fig. 7 applies to a vapor pressure of 0.12809 psia. Dry bulb temperatures and relative humidities corresponding to this vapor pressure are given below

Dry bulb temperature, F	Relative humidity, percent
41.3	100
45.0	87
50.0	71
55.0	60
60.0	50
65.0	42
70.0	35

Water and CO_2 Absorb Radiation

With the above information, the knowledge of the temperatures involved, the radiant heat transfer to the body can be determined. This assumes that no radiation is lost between the emitting surface and the receiver. While most gases, air included, are for practical purposes transparent to thermal radiation, some gases absorb and emit radiation in certain limited wave lengths. Two absorbing gases common in industrial atmospheres are carbon dioxide and water vapor. The bands in which these absorb radiation are given in Table 3. Radiation is absorbed progressively[2] in these bands so that the absorptivity is a function of the effective length the radiation travels (known as the beam length) before being intercepted by the enclosing surfaces. Additionally, the absorptivity of a gas depends upon the volumetric concentration of the gas or its partial pressure, and the temperatures of the gas and the emitting surface.

For industrial heat transfer calculations, the total absorptivity in all bands is of interest. The total absorptivities have been determined for various concentrations, temperatures and beam lengths.



8 TOTAL ABSORPTIVITY of water vapor-carbon dioxide mixture is less than sum of the absorptivities of the individual gases. Combined absorptivity is given here for the same conditions as stated in Fig. 7

For an elemental emitting area, a good approximation of the beam length is the distance between the surface and the floor. This has been used in subsequent calculations.

The absorptivities of carbon dioxide and water vapor are given in Fig. 7 for several mounting heights, emission temperatures, and specific concentrations of each gas. For water vapor, a partial pressure of 0.12809 psia has been assumed. This corresponds to an air temperature of 60 F and a relative humidity of 50 percent. Other air temperatures and corresponding relative humidities for the same partial pressure are given in Table 4. In the case of carbon dioxide, the values shown apply only for an air temperature of 60 F as its absorptivity depends upon both the gas and the emission temperatures. The concentration assumed for carbon dioxide is the American Conference of Governmental Industrial Hygienists MAC value of 0.5 percent.

The absorption of low temperature radiation (500 F) is considerably greater than that for higher temperatures. This is because the major portion of the radiation emitted by a surface at 500 F (See Fig. 2) occurs in the major absorption bands for water vapor (4.8 to 8.5 microns, and 12.0 to 30.0 microns). If the absorptivity of water vapor for a particular installation is 0.10, 90 percent of the radiation emitted by the heater will be transmitted and 10 percent will be absorbed. The absorbed radiant energy will be re-radiated by the vapor to the enclosure in an indoor installation, but it will reduce[6] the direct radiant energy received by a body. Thus, gaseous absorption must be considered only when direct radiation is important. This suggests that the radiant heater should be mounted as low as is practical to reduce the radiation lost by this means.

When both carbon dioxide and water vapor are present, the total gas absorptivity is less than the sum of the absorptivities of the two gases by a small amount. This is due to overlapping of the absorption bands of the two gases. The total absorptivity of a carbon dioxide-water vapor-air mixture at the conditions given in Fig. 7 is plotted in Fig. 8. These curves apply only to the specific conditions stated and the absorptivities at other conditions may be obtained from Reference 2.

In most cases, only the absorption of water vapor will be significant as the carbon dioxide concentration will usually be less than that for which the absorptivity has been determined. When only water vapor is present, the curves of Fig. 7 can be extended to other temperatures and humidities according to Table 4.

Radiation and Comfort

Infrared rays are primarily not destructive. Prolonged and intimate exposure[7] of the eyes to infrared radiation can cause cataracts. Cataracts from this source have been observed in such occupations as glass-blowing and foundry work. The near infrared rays (1.0 to 2.0 microns especially) are transmitted by the lens and focused on the retina. These are most liable to cause retinal burns[7] with exposures to intense radiation, such as that from the sun, and other high temperature sources. In general, the intensities required for comfort will be less than those causing eye damage. However, radiant heating units that emit a large quantity of their energy in these wave lengths should be located out of the subjects normal line of vision to prevent the possibility of excessive exposure.

The effect of radiation on the sensations of

warmth is of most interest in space heating applications. These effects are discussed in detail in References 3, 8, 9, and 10. Some of the relationships of interest are presented here.

The human skin absorbs infrared radiation almost like a "black body". The absorptivity for wave lengths greater than 2 microns is between 0.97 and 0.98. Visible rays and the shorter infrared waves are reflected to a much greater extent. For these waves, the absorptivity is about 0.75. For engineering problems an absorptivity of one may be used.

Radiation at wavelengths greater than 2 microns penetrates[8] the skin but is absorbed in less than 0.0008 in. Visible rays and the shorter infrared waves travel somewhat deeper before being absorbed, but virtually all radiation is absorbed within 0.0012 in. These differences in penetration are responsible for the designations in Fig. 1. For either type of radiation, it is evident that the radiant energy warms the surface of the body.

Studies have shown[8] that the minimum amounts of incident radiation required to produce a sensation of warmth varies with visible, penetrating and non-penetrating radiation. The quantities of incident radiation required to produce a sensation of warmth after a three second exposure vary in a 3 to 2 to 1 ratio for the three types, respectively. That is, the skin is less sensitive to short exposures of the visible and penetrating waves than it is to the non-penetrating waves of the far infrared region. Conversely, this can be interpreted to mean that a smaller quantity of the far infrared radiation is required to produce a sensation of comfort. For prolonged exposure, the total energy supplied to the body is the criterion that must be satisfied.

Additional studies show[8] that a change in radiation of 0.00055 Btu per sq ft per second or about 2 Btu per hr per sq ft will evoke a sensation of warmth. This emphasizes the importance of achieving as near uniform as possible radiation intensity if the subjects move about within the space and direct radiation is relied upon for comfort.

The ultimate purpose of all heating is to provide just the right environment for the subject so that the net body heat loss is that required for the body to achieve comfort. The body loses heat by three mechanisms: radiation, convection, and evaporation. Much is yet to be learned about the effect of each of these on comfort sensations to permit prediction of the exact amount of radiant energy that must be supplied to the body at any given condition of dry-bulb temperature, wet-bulb temperature, and air speed. An approximation of the radiant energy necessary for comfort when the subject is exposed to various air temperatures can be obtained from the Raber and Hutchinson comfort equation[3]. This equation is based upon body heat production and the radiative and convective losses in still air assuming the evaporative loss remains constant. This is derived for the heat production of a normally clothed sedentary individual assuming that a clothing temperature of 82.4 F is maintained. An adjustment is made in the ratio of radiation heat loss to convection heat loss to take the effect of air speed on convection heat loss into account in a limited way. The result of their analysis produces the following equation relating air temperature and mean radiant temperature.

$$T_a + T_{MRT} = 140.$$

Assuming this equation can be applied over a wide range of air temperatures, the direct radiant energy needed for comfort of a subject can be obtained for various temperatures of the air and surroundings. The quantity of heat that must be supplied by direct radiation is equal to the difference between the radiation loss of the body to the surrounding cold surfaces and the radiation loss of the body at the mean radiant temperature required for comfort as found from the Raber-Hutchinson equation. The direct radiation required — as determined by this means — is listed in Table 5 for several air temperatures. The conditions assumed in determining these values in addition to those involved in the derivation of the equation are:

1) The clothed body has an area of 19.5 sq ft for radiant heat transfer.

2) The unheated surface temperature or the temperature of the enclosing surfaces is equal to the air temperature.

3) The emissivity of the surface of the clothing is 1.0.

The values in Table 5 are given only as an approximation of the total direct radiation requirements for various air temperatures. If used for design purposes, they should be used with considerable judgment. For the working subject, these values will be high since net body heat loss must increase to offset, in part, the increase in body heat production. For high air motion, the values will tend to be low, although air speed has been par-

tially accounted for. Another important consideration is the amount of the exposed surfaces — exposed walls, ceiling, and glass — seen by the subject. One subject located so that he radiates to several walls and the ceiling will need more radiation than one located in the midst of other objects, such as equipment, that will be warmed by the direct radiation.

The type of clothing worn by the individuals will also affect the direct radiant heat transfer required to provide a comfortable environment. With heavy clothing, the surface temperature will be lower and the body will lose less heat by radiation and convection to its surroundings. An excellent discussion of the effects of clothing on comfort can be found in Reference 10.

It is most desirable that the direct radiation be uniformly received by the subject for overall warmth and comfort. Irradiating the subject from one side with the proper intensity would provide sufficient heat at the expense of a toasted front side and a chilled back side.

One other factor affecting comfort in radiant heated spaces that should be considered is the effect of radiation received[11] by the head. Studies in England have indicated that for conditions there, the incidence of discomfort in radiant heated spaces is closely associated with the elevation of the mean radiant temperature (MRT) at head level above that for the unheated surfaces. On the basis of this investigation it was recommended that the elevation of MRT not exceed 4.0 F. At this condition, the incidence of discomfort based upon uncomfortable warmth at the head was 8 percent and the incidence increased to 40 percent at a 12 F elevation of MRT. Thus, it would be expected that complaints of excessive warmth of the head would increase as the air temperature maintained in a space is lowered because the MRT must effectively increase to maintain overall comfort of the body. This again points to the importance of distributing the heating surface for uniform irradiation of the heated space. That is, a single high output unit providing the required average MRT in the space would cause local areas of high MRT and, thus, some discomfort. If a number of smaller units with the same total capacity are installed, a more uniform MRT will result and local hot spots will be eliminated.

Table 5 — TOTAL RADIATION heat transfer to a subject that is required to maintain comfort at various air temperatures based upon the Raber-Hutchinson comfort equation. These are only an approximation of the amount required and are limited by the conditions stated in the text

Air and unheated surface temperatures, F	Required mean radiant temperature by equation, F	Rate of direct radiation heat transfer required for comfort, Btu per hr
40	100	1190
45	95	880
50	90	800
55	85	585
60	80	410
65	75	210
70	70	0

Some Considerations in Application

As mentioned earlier, a number of radiant heating units are available. The direct-fired gas units are available with gross capacities ranging from 24,000 to 144,000 Btu per hr. Electric infrared bulbs are available in a wide range of wattages. The capacity of the electric infrared heater depends upon the number of bulbs used in the assembly and their wattages. Some such heaters are available in capacities ranging from 3,400 Btu per hr to 13,600 Btu per hr. Higher capacities can be obtained with any type of unit by grouping heaters when this is desirable from the standpoint of distribution of the radiant surface and local radiation requirements.

The portion of the gross capacity of the radiant heater that is delivered to the space as thermal radiation will depend upon the success with which the convection losses from the heater are minimized. In the case of fuel fired units, the combustion efficiency will also be important in determining the radiant heating capacity. Reported values of radiant heating capacity for electric infrared bulbs range from 65 to 80 percent. That is, from 65 to 80 percent of the electrical energy supplied to the bulb will be transmitted to the space as thermal radiation. The radiant capacity for some direct-fired gas units has been reported[12] as being about 60 percent of gross capacity.

The desirability of minimizing the convection loss from the radiant heaters is evident because of the height at which they are usually mounted.

Since they are not equipped with air distribution devices, the heat lost by convection rises and stratification occurs beneath the roof of the structure. This heat does not contribute to the comfort of the occupied space except through warming of the ceiling or underside of the roof which reduces to some extent the radiative loss of the occupants. Where infiltration rates or ventilation rates are very high and the incoming air enters near the floor, the convection portion of the heaters capacity will contribute little to the space comfort.

Reflectors Change Radiation Pattern

In most available radiant heating devices, the radiant waves are concentrated by means of reflectors. This tends to increase the intensity of radiation beamed at the floor and to limit the area irradiated by the heater at any given mounting height. Furthermore, it will tend to limit the radiant heat exchange with the cold surfaces of the enclosure thereby reducing the heat loss of the space.

The effect of the reflector on the configuration factors shown in Figs. 3 through 6 will be appreciable for good reflector design. In computing the configuration factors, it is assumed that the radiation is received from a plane surface radiating in all directions from its surface. For locations immediately beneath the unit in the case of ceiling mounted heaters or for locations within a few feet of a heater with vertical radiating surface, these factors will represent a reasonable approximation of the true configuration factor. They will be in error on the low side, but by a rather small amount since the reflected waves represent a small part of the total radiation from the surface. As the subject moves further from the centerline of the unit, the discrepancy will become increasingly greater on the high side as the subject will receive less radiation than would be indicated by the configuration factor.

Spot Heating with Radiant Units

The applications of radiant heating mentioned earlier—spot heating in warehouses, loading areas etc. and complete heating of an industrial shop—must be treated somewhat differently in design. In the case of spot heating, the heater location and radiant capacity must be fitted to the needs of the individual or individuals to be heated. From Fig. 5 and 6, it is evident that a small portion of the radiant energy emitted is actually used to warm the subject. For the conditions shown, the maximum utilization of direct radiation amounts to 1 percent. Some additional radiation will contribute to comfort as a result of radiation and convection from other surfaces that are warmed, but this form of heating is relatively inefficient by comparison with usual standards. However, since comfort can be achieved without heating the entire enclosure to a comfortable temperature, the cost of spot heating by this means will be less than that for other systems.

For economy when heating open areas, such as areas near doors or on open loading docks, the radiant heaters should be located so that they beam a minimum amount of radiation in the direction of the open air while providing the required intensity on a subject working in the area. For example, on a loading dock much is to be gained by locating the radiant heater at the outer edge of the dock and beaming the rays back toward the building proper. In this way the surrounding surface will be warmed and will contribute to the overall comfort level and the direct heat loss to the surroundings will be minimized.

In an interior location that is to be spot heated, the use of several heaters will produce a more comfortable environment and may require less heater capacity than when a large single heater is employed. For example, with ceiling mounted heaters, a subject receives a maximum amount of radiation from the heater when he is at some distance from the heater rather than when he is directly beneath it. This is because only the top of the head and shoulders receive radiation when he is under the unit. For a heater located 12 ft above the floor, a standing subject receives[4] the maximum thermal radiation when he is about 5 ft from the center of the heater. At this position he receives about 1.2 percent of the energy emitted by the heater. When immediately beneath the heater, he receives only half as much radiation. For a given required radiant heat transfer to the subject, the radiant capacity for one heater located immediately above the subject, would be twice that required when the heater was situated 5 ft in front of the subject. If two heaters were used, one five feet in front of the subject and one

five feet behind the subject, the total capacity required would also be one-half that for the heater located overhead, but each heater would have a capacity one-fourth that of the overhead unit. Additionally, the heating would be more uniform.

For vertical panels that emit their maximum radiant energy parallel to the floor, the total heating capacity will be required whether the subject is irradiated only from the front or from both the front and back. For a fixed heater capacity, the distance between heater and subject must be varied to obtain the required heating of the subject. The fraction of radiant capacity received by the subject can be varied over much wider limits with horizontal radiation than it can with the panels located in the ceiling. Both the mounting height of the heater and the distance between the subject and heater affect the total radiation received. For example, with the heater located 4 ft above the floor and 2 ft from the subject, the subject receives[4] about 30 percent of the radiant energy emitted by the heater. If the subject moves to a distance of 12 feet from the heater he will receive only 1 percent of the radiation emitted. Thus, some care must be exercised when locating vertical panels to provide optimum heating of the subject. With the maximum intensity of radiation emitted horizontally, the incidence of discomfort due to warming the head will be minimized as the head will receive less radiant energy.

Radiant Heating of Large Spaces

When heating an entire space by means of radiant heaters, the comfort of the space is governed by two factors; the direct radiation received by the subject from every heater that his body "sees", and the warming of the air in the space that results from convection heat transfer from the floor and other surfaces that are heated. A balance must be achieved between the two heating effects within which the body can adjust to attain comfort. Where infiltration rates are high, direct radiation should be depended upon for attainment of comfort to minimize the cost of heating the infiltrating air. The maximum ventilation rate for which this will be successful must yet be determined. At very high air change rates due to industrial ventilation, consideration should be given to the use of a makeup air system to temper the incoming air required to maintain a suitable pressure balance. This may also be necessary when direct-fired heaters are used to assure proper venting of the flue gases. Where infiltration is a minimum, the air temperature will more closely approximate normal room air temperatures and the direct radiation to the subject can be reduced.

In present designs for enclosed spaces, such as crane bays, garages, machine shops, etc. the heat loss of the space is calculated as it would be for conventional heating systems taking into account the air temperature that will be maintained in the space. In general, a lower design indoor temperature would be permissible. The total capacity of the units is selected to equal this heat loss. This has been found to produce acceptable[12] results.

Some general rules to follow in locating units for good distribution and utilization are:

1) Locate at least one row of heaters arranged for uniform distribution along each exposed wall to offset radiant losses in this area and to compensate for infiltration and heat transmission through the wall and floor.

2) Treat the areas near doors that will be opened periodically to permit large amounts of infiltration as a spot heating problem so that the direct radiation gains to the workers will effectively offset the reduced air temperature.

3) Locate the remainder of units in a pattern that will achieve uniform distribution of radiation in spaces normally occupied.

4) Avoid locating units where structural members and machinery will cast cold shadows on the subject. The infrared waves will be absorbed or reflected so that they do not reach the subject.

5) Watch placement so that combustible materials and sensitive equipment are not overheated by either direct radiant heat transfer or by contact with the heater. Shielding with aluminum sheets will provide protection from radiation.

6) When heaters emit a large portion of their radiant energy in the visible and near infrared regions, avoid direct irradiation of glass surfaces. Glass will transmit about 75 percent of the incident radiation at these wave lengths. In the far infrared region, only 5 to 10 percent is transmitted.

How They Are Controlled

The control of direct radiant heating systems is accomplished[12] in two ways. A simple on-off

control is sometimes used for this purpose. Heat demand is supplied either on a scheduled basis during working hours or at the discretion of the foreman. Information as to the success of this type of control is unknown. However, since radiation plays an important part in the sensation of warmth, it would seem that control by this means would not be too desirable. It is quite likely, especially in spot heating applications, that this type of control would lead to other than comfortable conditions the greater part of the time. Under conditions that would cause overheating with the unit on, it is possible that radiation to the cold surfaces with it off would cause underheating. This would be tempered only by heat storage in the floor and equipment since the radiant heater is essentially a low-mass rapid response unit. Suitable adjustment of comfort could be made by the subjects by changing their location with respect to the heating unit. However, this assumes that the work station is not fixed or that the distance between the subject and heater can be varied by changing the elevation of the heater.

The second means of control employed—especially in spaces which are completely heated by radiant heaters—is an ordinary room thermostat with suitable radiation shielding. The thermostat is set to maintain either a predetermined air temperature in the occupied space or perhaps the temperature which is found by experience to produce the most comfortable condition. This type of control will tend to compensate for shortcomings in design since the air temperature can be raised or lowered to adjust for the direct radiation actually received by the subjects. Some consideration should be given to zoning with this type of control where widely different infiltration losses or radiation losses to cold surfaces occur. The fluctuations in air temperature with heater operation will likely be small due to the flywheel effect of the floor and surrounding surfaces. In extreme exposures, the change in mean radiant temperature when the units are turned off may produce discomfort. Zone control would tend to overcome the effects of this.

Operating Costs

Only limited evidence is presently available to estimate differences in the operating cost of the radiant heaters and conventional systems. In some cases reported, the cost is considerably less than estimates for other types of heating. In others the costs are about the same or somewhat higher than those for conventional systems. This latter agrees with experience with conventional low temperature panels. The lower costs are likely to occur when the air temperature is reduced and comfort maintained by increasing the mean radiant temperature. The cost of warming infiltration air will be lowered by this means.

Use Insulation For Minimum Cost

It should be noted that following good principles of insulating will be as advantageous with this type of heating as it is with any. Where the walls are irradiated by the heaters, a reflective type of insulation will minimize the heat losses. Aluminum foil, aluminum paint, or even galvanized sheet iron (emissivity ranges from 0.25 to 0.28 depending upon degree of oxidation) will serve to reduce these losses. When normal air temperatures are maintained, batt or blanket insulations will be needed if minimum operating cost is desired. These also contribute to comfort as they increase the interior surface temperature.

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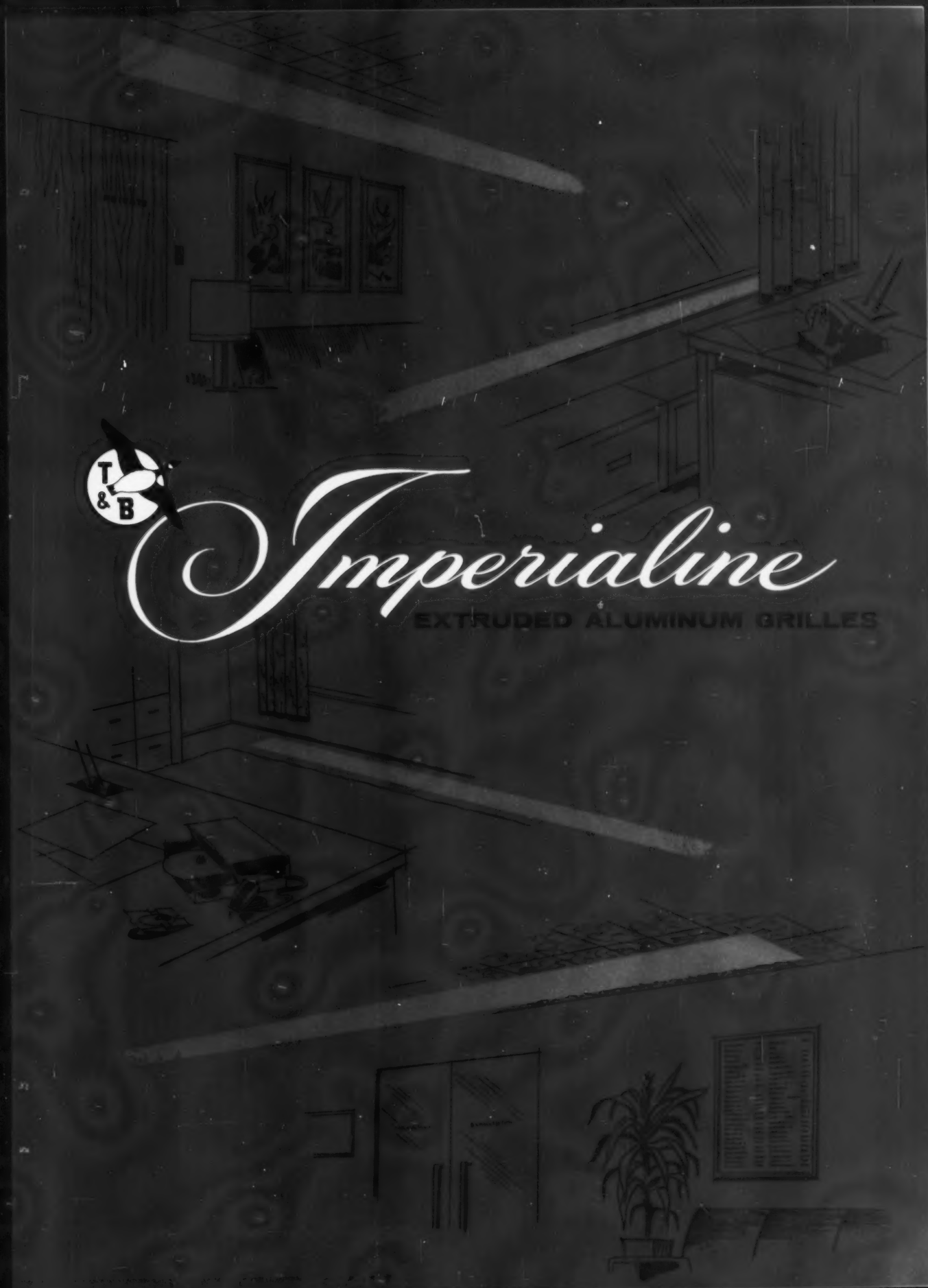
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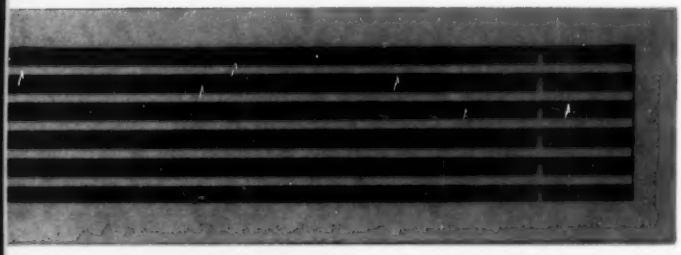

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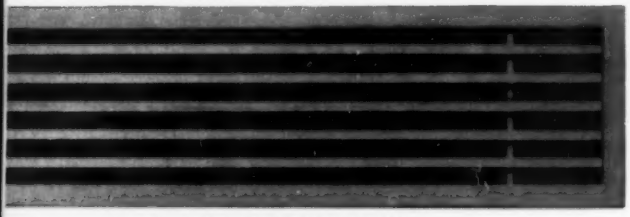

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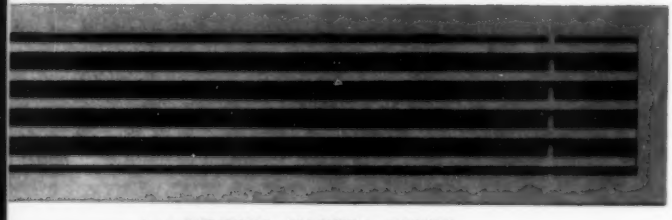

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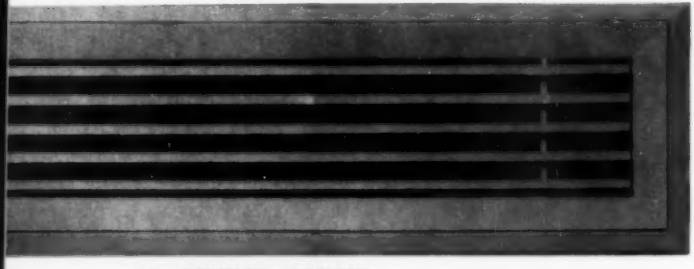

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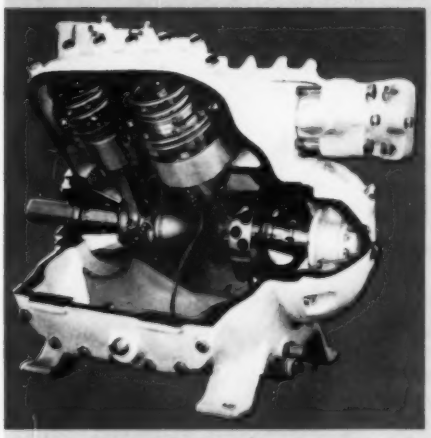

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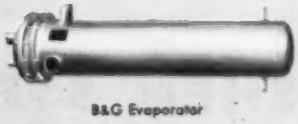

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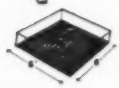

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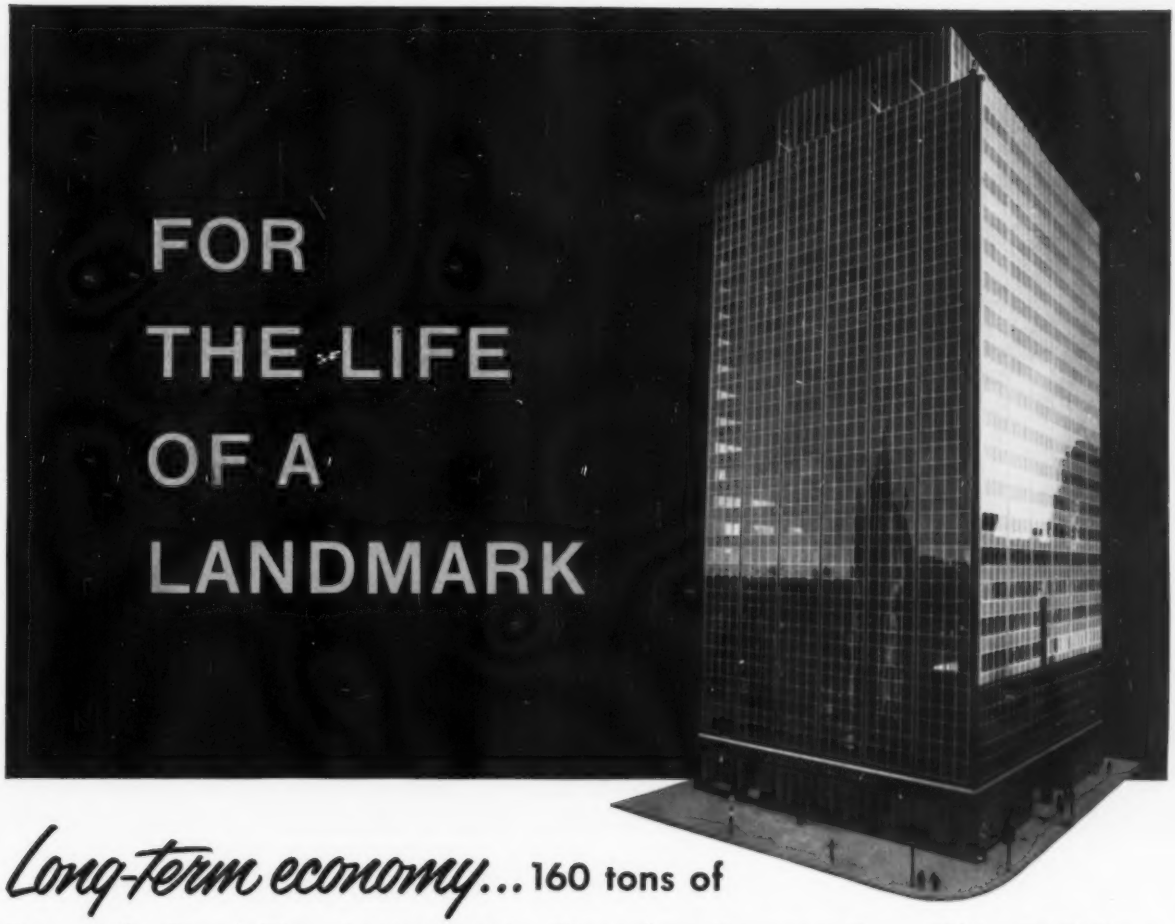


Long-term economy... 160 tons of Republic Steel Pipe installed in Cleveland's new East Ohio Building

STEEL PIPE IS FIRST CHOICE

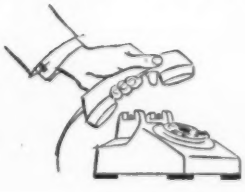
- Low cost with durability
- Strength unexcelled for safety
- Formable—bends readily
- Weldable—easily, strongly
- Threads smoothly, cleanly
- Sound joints, welded or coupled
- Grades, finishes for all purposes
- Available everywhere from stock

INSIST ON PIPE MADE IN U.S.A.

The Gorman-Lavelle Plumbing and Heating Company installed Republic Steel Pipe in this new Cleveland landmark. *Steel pipe*—160 tons of it—because steel pipe is good for the life of a building, and costs considerably less initially. *Republic Steel Pipe*—because Gorman-Lavelle demands the highest possible degree of workability.

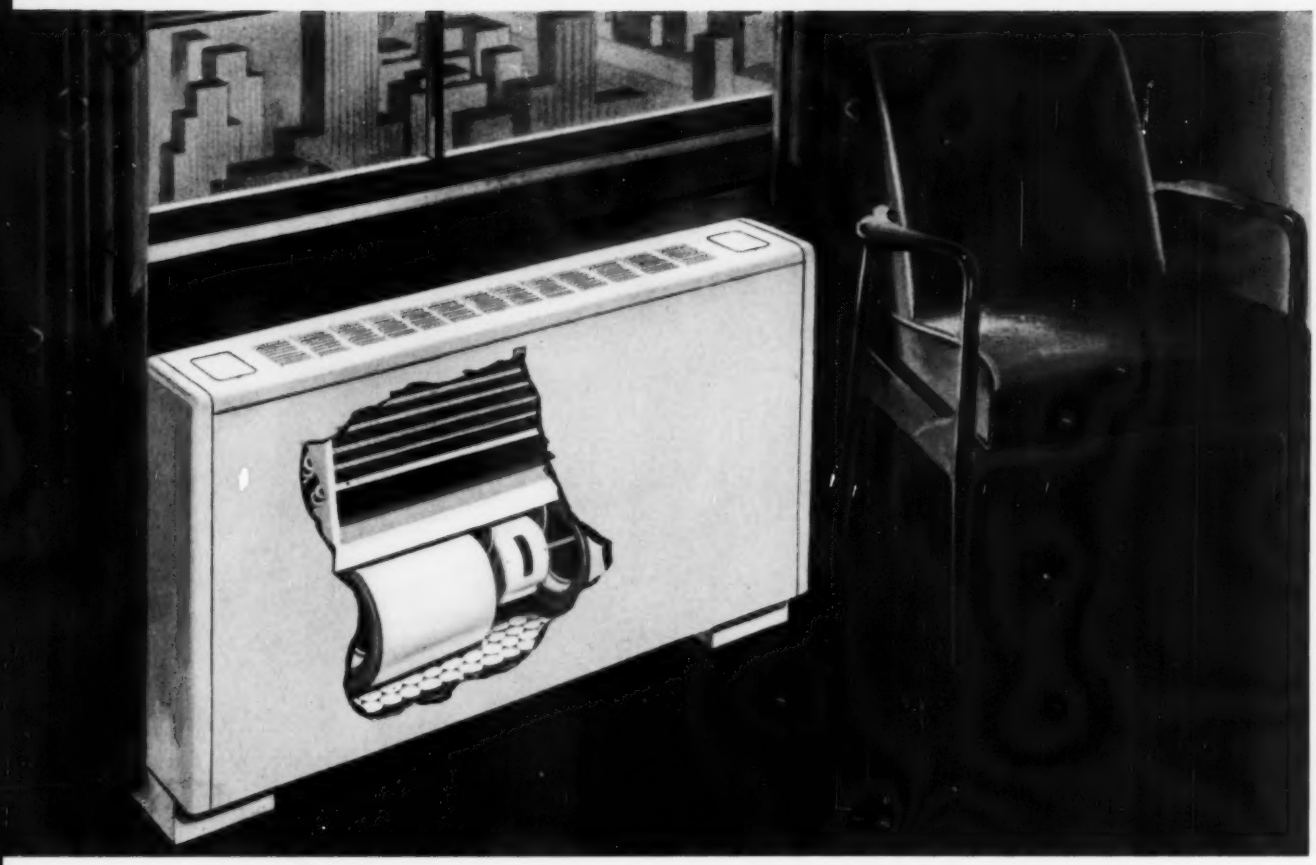
That workability is assured by Republic's constant quality control. You profit from easier bending, cutting, and threading. And, you can rely on the strength of steel for long, unsupported runs; on the availability of steel for minimum variation in delivery; on the tight galvanized coating of Republic Steel Pipe for stubborn resistance to corrosion and fabrication damage.

Learn more about the many outstanding economies that are yours with Republic Steel Pipe. Your local Republic distributor carries sizes and grades for every purpose. Contact him for complete information or write Republic Steel Corporation, Dept. HP-7521, 1441 Republic Building, Cleveland 1, Ohio.

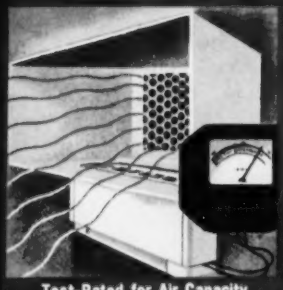


CALL YOUR LOCAL REPUBLIC DISTRIBUTOR FOR QUICK DELIVERY OF STEEL PIPE

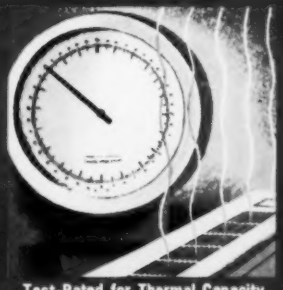
REPUBLIC *Steel Pipe*



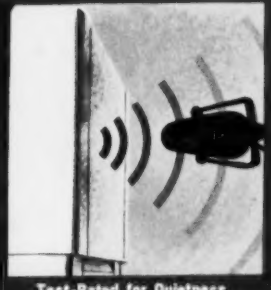
THE UNITS: All Type 20 fan-coil units are a space-saving 9″ thin and 25″ low with individual-room-unit control for complete operating flexibility. They're available in three convenient models and four practical sizes, either recessed or free-standing. Remotaire units are exceptionally quiet because of slow-speed motors (1,050 rpm max.), large coil surface and filter area, heavy insulation, no reactors or autotransformers.



Test-Rated for Air Capacity



Test-Rated for Thermal Capacity



Test-Rated for Quietness

Test-Rated for Humidity Control

electrical characteristics

unit size	motor input watts	nameplate amps	locked rotor amps	power factor
	shaded pole motors			
200	64	0.8	1.1	.69
300	107	1.4	1.9	.67
400	108	1.4	1.9	.67
600	168	2.5	3.5	.59
	permanent split capacitor motors			
200	36	.32	.41	.98
300	70	.68	.98	.90
400	72	.70	1.15	.91
600	110	1.10	1.80	.87

note: based on 115/1/60 power supply, motor at high speed, basic controls.
With solenoid valves, add 0.2 nameplate amperes and 11 watts.

IMPORTANT!

DON'T OVERLOOK ELECTRICAL CHARACTERISTICS WHEN YOU SPECIFY FAN-COIL UNITS

You'll save both wiring and operating costs

Significant savings result when you choose fan-coil units with permanent split capacitor (psc) motors. By using American-Standard Type 20 Remotaire year 'round air conditioning units, you can choose either psc motors (optional) or shaded-pole motors (standard). Specify the optional psc motors, and you can expect the following savings:

Initial cost is low, because low current input of permanent split capacitor motors allows more units to be installed on each fused circuit—saving on wiring, switch gear and panel boards. By specifying psc motors in any of the four individual sizes of Type 20 Remotaire units, only half the number of current-carrying circuits are needed, as when shaded pole motors are used.

Operating cost is low, because of the careful matching of motor to fan load, high power factor and low power consumption (watts).

Here's a specific example in an office building with 400 units each of 400 cfm capacity. At 1,050 rpm and 115v, single phase, 60 cycles, the power input for the size 400 Type 20 is 108 watts with the standard shaded pole motor; 72 watts with the optional psc motor. Therefore, with the psc motor, the power saving is 36 watts per unit or 14.4 KW for the 400 units. A saving of 14.4 KW amounts to 144 KWHRS energy saved per 10-hour day. In a 250-day business year, total energy saved is 36,000 KWHRS. The saving, at $.02 per KWHR, is $720 a year. The extra cost for psc motors would be recovered in about 4 years. Thereafter you save $720 a year.

All American-Standard 60-cycle motors used in Type 20 units include six-pole electrical construction, three built-in speeds with four simple color-coded leads.

Type 20 Remotaire units are part of a hydronic* system in which the same small-diameter, flexible pipes carry hot water for heating and chilled water for cooling from a central boiler-chiller team to these under-the-window fan-coil units.

For a full description, see your American-Standard representative or write AMERICAN-STANDARD, PLUMBING AND HEATING DIVISION, 40 W. 40 St., New York 18, N. Y.

**Hydronics—the science of heating and cooling with water*

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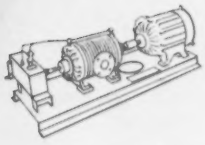
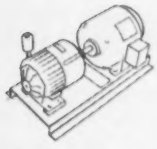
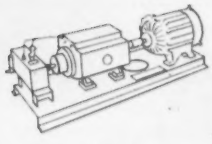


Air Cooled Units



Fan Cooled Units



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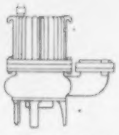

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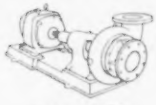

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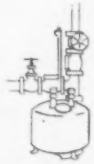

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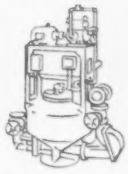

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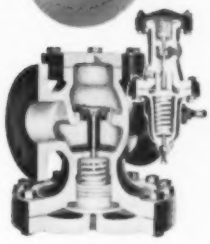

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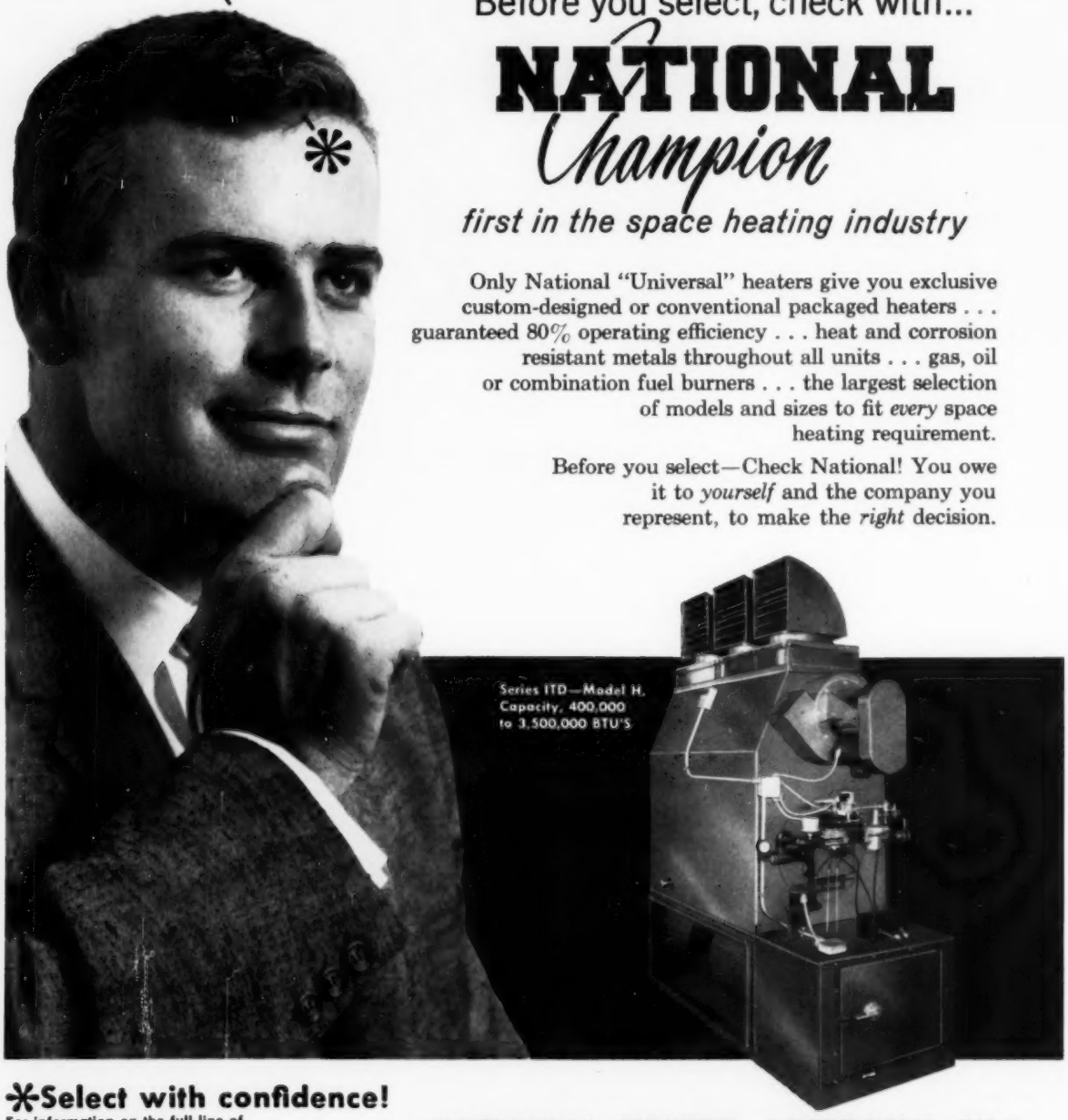

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When specifications call for an exhaust fan with BIG air moving capacity, they call for Jenn-Air's new "Hi-D" Power Exhausters. Designed in both axial and centrifugal wheel models, these belt drive units offer capacity ratings in a broad range from 480 to 28,650 cfm.

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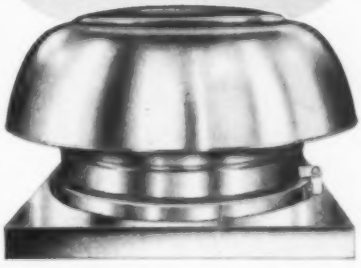
- Bird guard of heavy gauge stainless steel is an integral part of every unit.
- Maintenance-free aluminum housing provides strength without weight.

The HAB Series of "Hi-D" Exhausters (axial blade) gives highest air-per-dollar value in short duct runs where static pressures are negligible. The HCB Series (centrifugal wheel) effectively overcomes static pressures and is usually preferred for long duct runs. Its smaller diameter permits a corresponding reduction in duct size.

JENN-AIR All-Aluminum LOW-CONTOUR RELIEF VENTS



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Ask your Jenn-Air representative for performance and dimensional data on the complete line of Jenn-Air Power Exhausters and Relief Vents.

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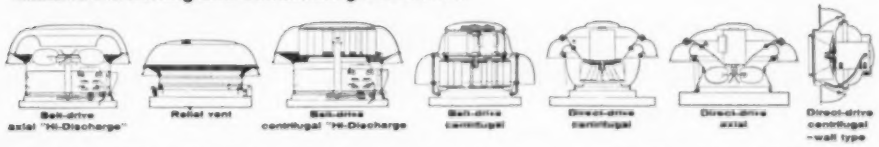

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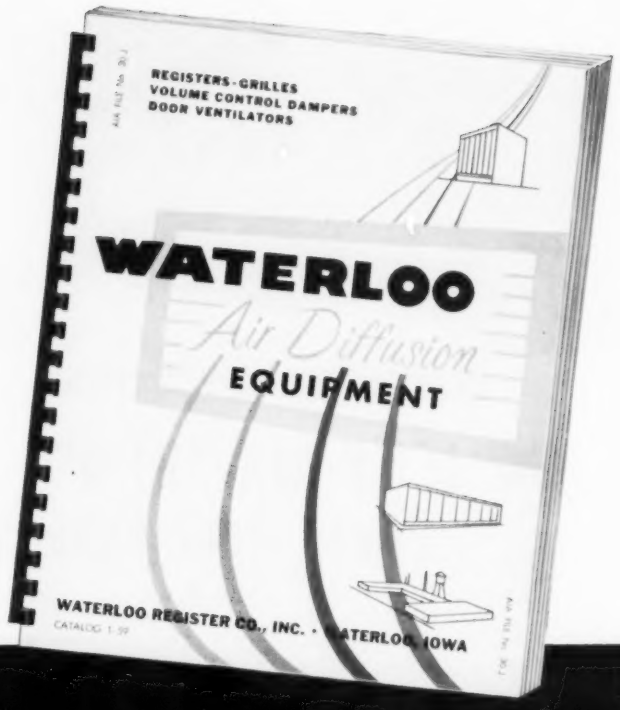

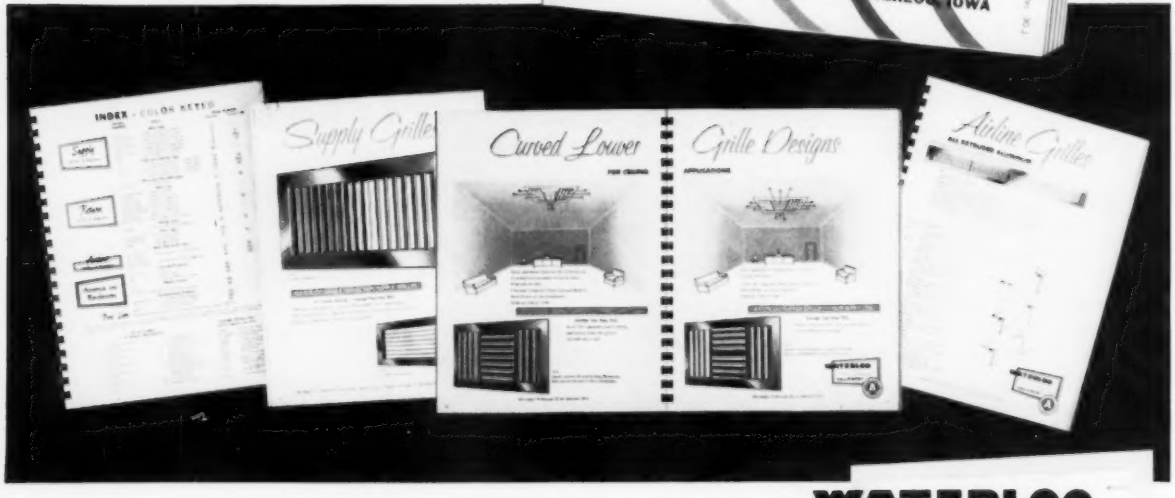

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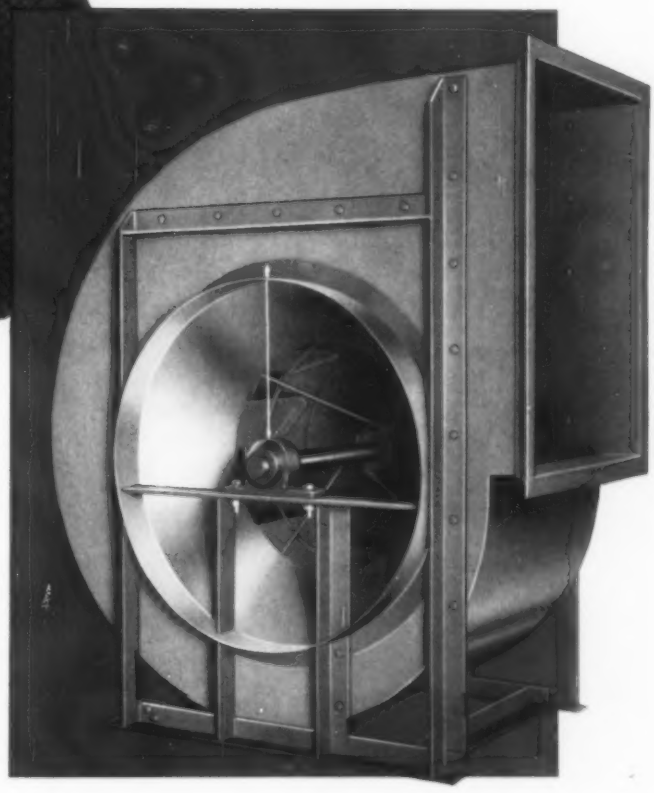

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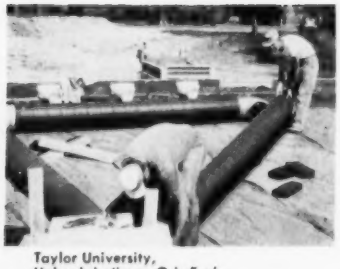

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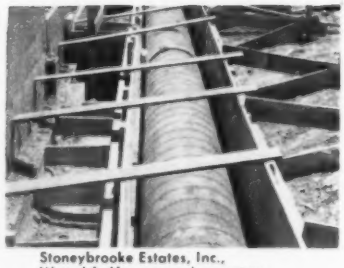

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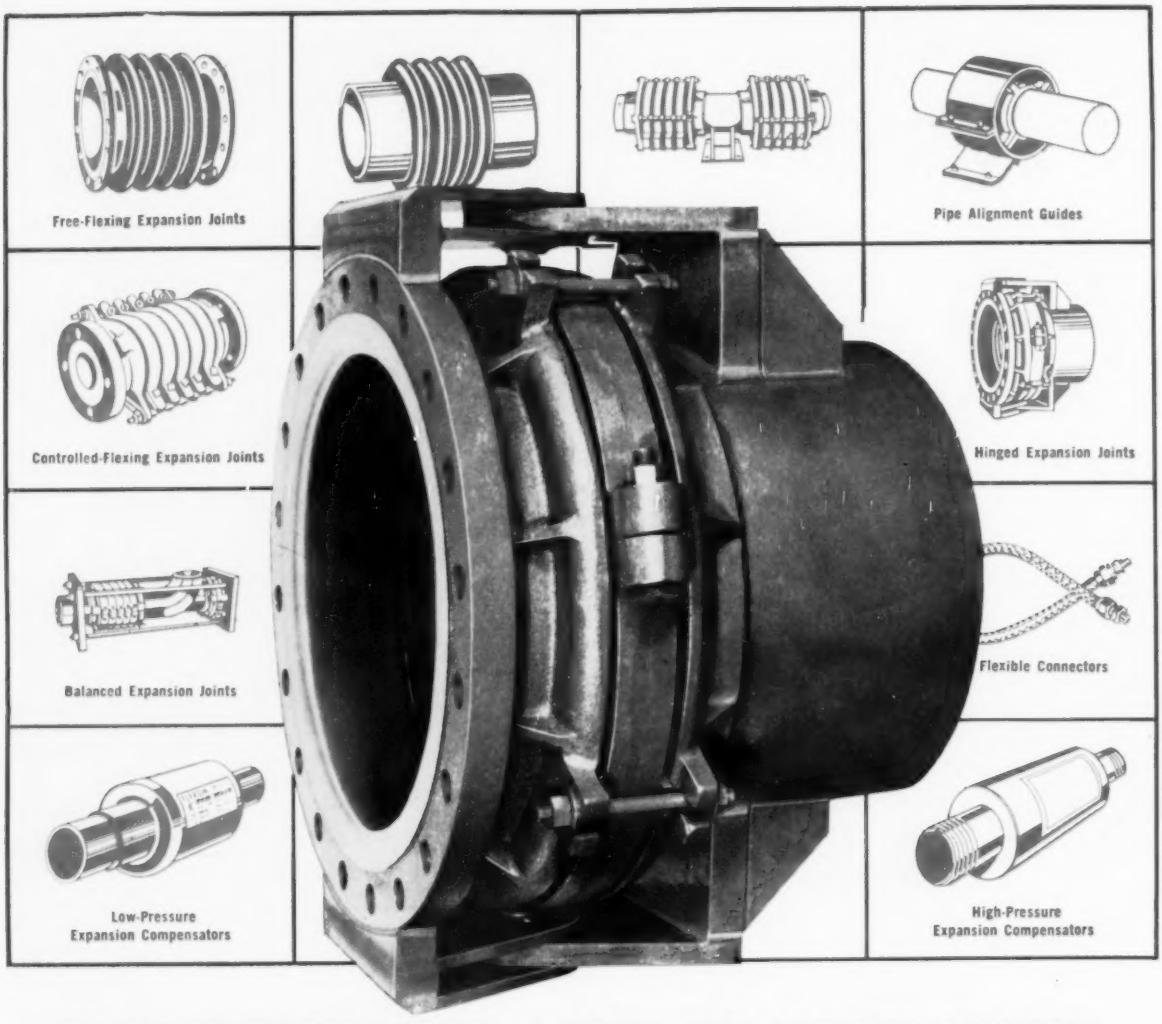

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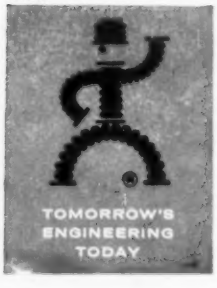

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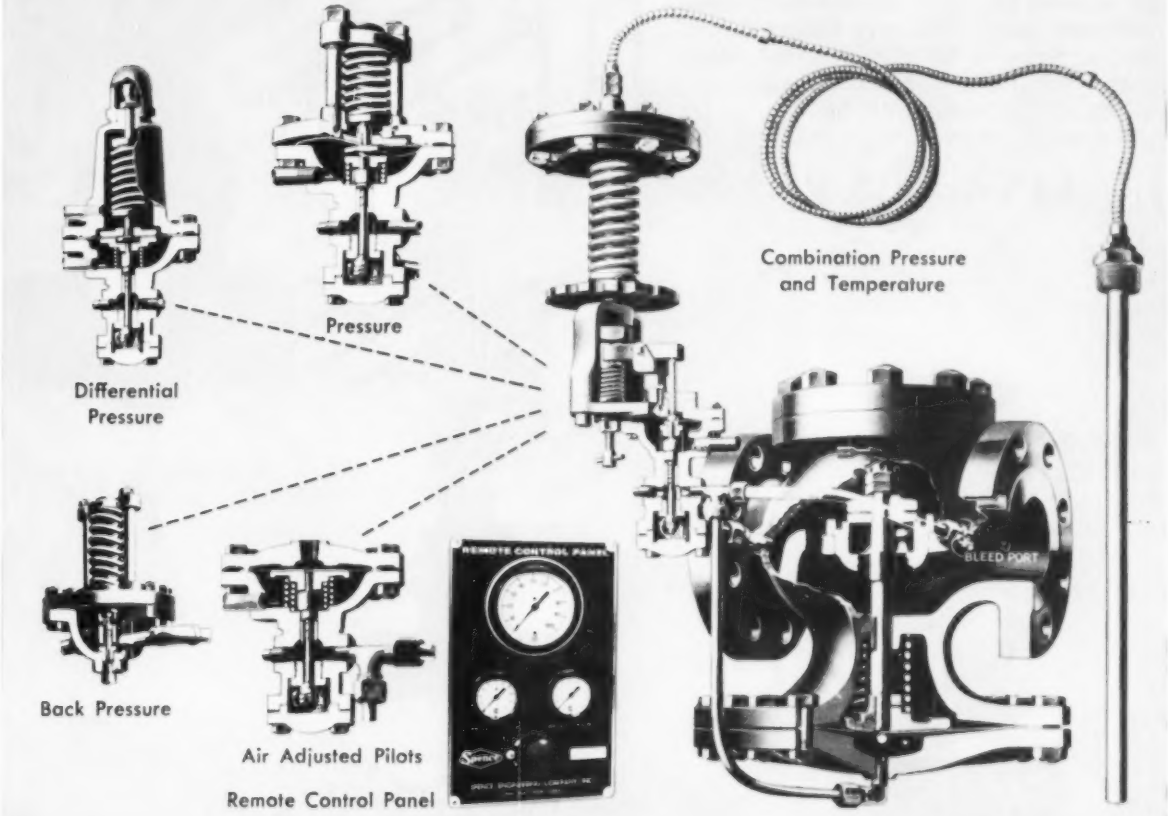
All Pilots Fit All Main Valve Sizes Downtime, Maintenance, Inventory Reduced



Let's start off by admitting there's no such thing as a "maintenance-free" regulating valve. Any valve that automatically controls temperatures or pressures within close limits can be affected by dirt in steam lines.

If trouble does develop, engineers want a regulator they can get back on the line — fast. That's one reason why more engineers are standardizing on Spence Regulating Valves with externally mounted pilots. The simple test of disconnecting the external bends establishes whether the trouble is in the main valve or the pilot.

If the main valve is the trouble spot, it can be maintained without removing the valve body from the line. If the pilot is the trouble spot, it is easily removed for cleaning. However, if production downtime is a strong factor, the fastest method is to install a spare pilot and it is inexpensive.

All Spence pilots fit all sizes of Spence main valves. If you have twenty pressure regulators, for instance, all you need is *one spare pilot*. It will fit all main valve sizes from ¼" to 12".

Another advantage of the Spence design is the external pilot is interchangeable. You can change the function of a regulator by merely changing the pilot. In many plants this can represent an important factor in reduced inventory costs because you only carry a few inexpensive extra pilots instead of complete regulators. Obviously, there is also a considerable savings in labor costs when a valve can be converted, in the line, from a temperature regulator to any one of various pressure regulators.

The pictures above show a few of Spence's wide line of automatic regulators. For more information write for Bulletin TE.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York 58-148

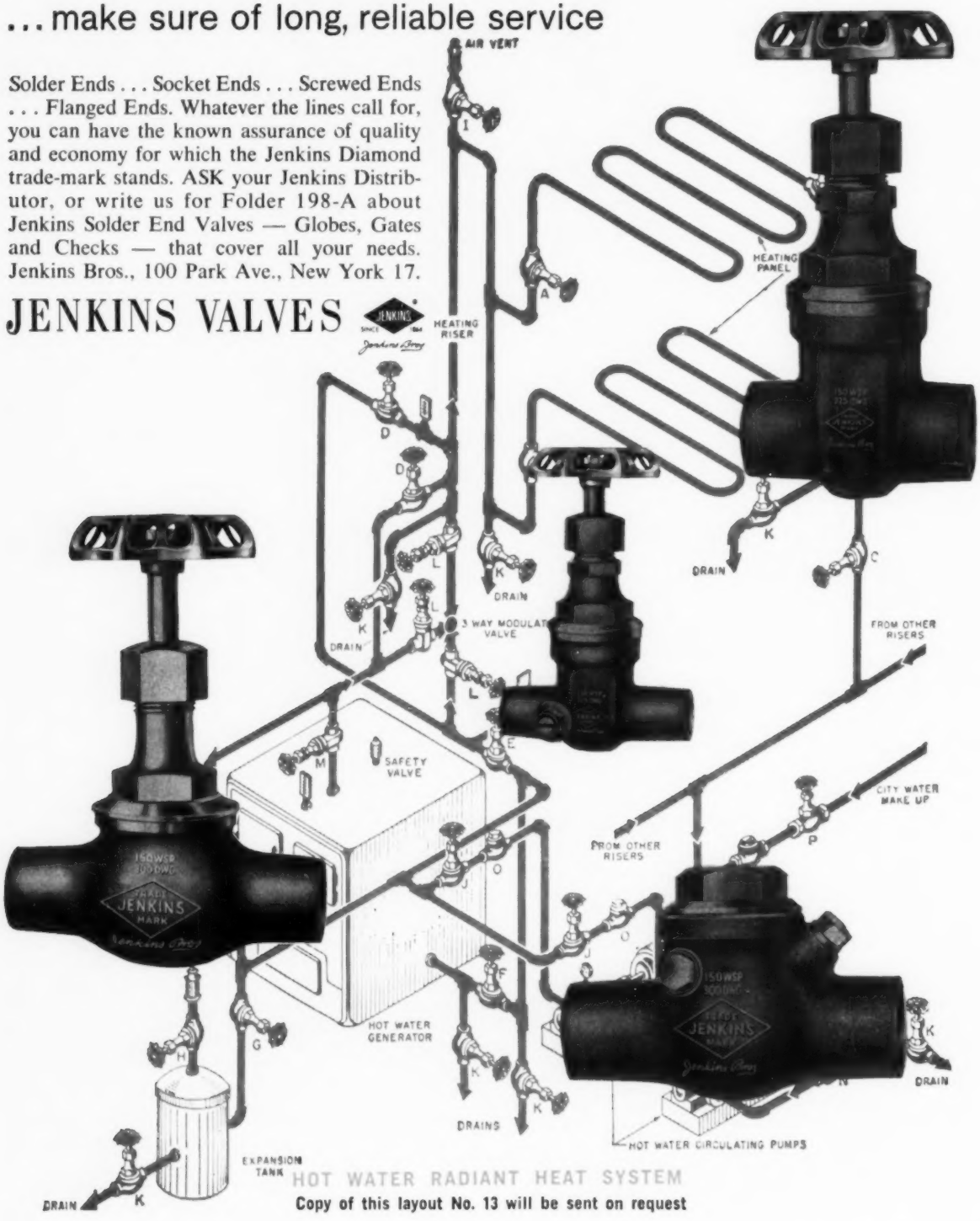
Look for this... JENKINS®

on **SOLDER END Valves,** too

... make sure of long, reliable service

Solder Ends . . . Socket Ends . . . Screwed Ends . . . Flanged Ends. Whatever the lines call for, you can have the known assurance of quality and economy for which the Jenkins Diamond trade-mark stands. ASK your Jenkins Distributor, or write us for Folder 198-A about Jenkins Solder End Valves — Globes, Gates and Checks — that cover all your needs. Jenkins Bros., 100 Park Ave., New York 17.

JENKINS VALVES

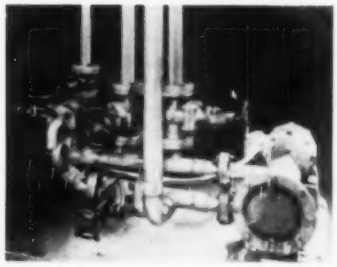


HOT WATER RADIANT HEAT SYSTEM

Copy of this layout No. 13 will be sent on request

EQUIPMENT DEVELOPMENTS . . .

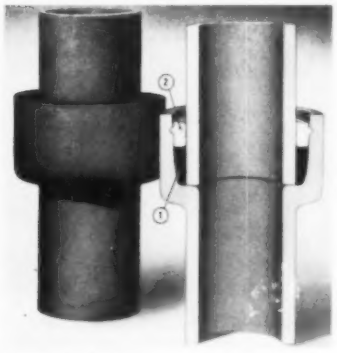
For reviews of Recent Trade Literature see page 194



Aluminum Fittings . . .

. . .for Schedules 10 and 40 pipe—*Speedline Div., Horace T. Potts Co., Erie Ave. & "D" St., Philadelphia* 34, *Pa.*

Fittings include 45 and 90 deg elbows, caps, eccentric and concentric reducers and stub ends; joints may be butt or socket welded with aligning connectors.



Pipe Joint . . .

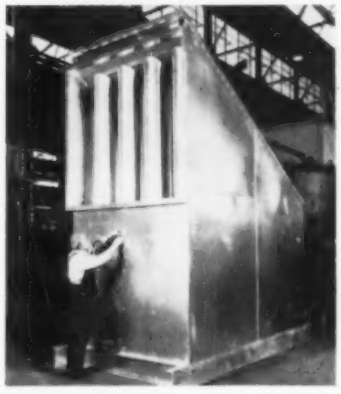
. . . Provides seal that cannot be broken by acids, solvents or heat, according to manufacturer—Maurice A. Knight Co., Dept. HPAC, Akron 9, O.

Does not require melting pots, flame or heat; complete information in company bulletin "1813-U" on request.

Plastic Lined Fittings . . .

. . .rated at 190 F and 175 psi test pressure—*Tube Turns Plastics, Inc., Div. of Chemetron Corp.*, 2929 *Magazine St., Louisville* 11, *Ky.*

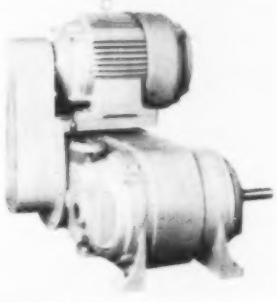
Fittings include 90 and 45 deg elbows, tees, with flanged or grooved ends in sizes 8, 10, and 12 in.; made of light-wall carbon steel with fabricated lining of 3/32 in. UPVC.



Dust Collector . . .

. . .for use in cement plant applications—*American Standard Industrial Div., Detroit* 32, *Mich.*

Contains 15 in. vertical steel inlet tubes; outlet tubes tapered to reduce plugging and to provide optimum collection efficiency.



Variable Speed Drive . . .

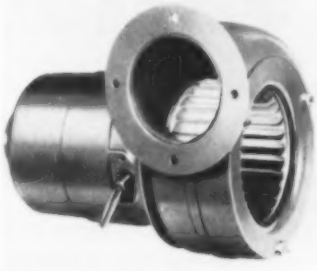
. . . featuring separate motor construction and horizontal assembly—Sterling Electric Motors, Inc., Dept. HPAC, 5401 Telegraph Rd., Los Angeles 22.

Available in ½ through 30 hp with output speeds from 4660 to 1.2 rpm; speed variations from 2:1 to 10:1. Bulletin "195" available on request.

Compensating Flue System

. . .designed with twin dampers—*Eclipse Fuel Engineering Co.*, 1139 *Buchanan St., Rockford, Ill.*

Developed for blast-fired gas furnace, boiler or other heating device with minimum of 10 cu ft of air for each 1000 Btu of fuel burned; all air required by combustion system is replaced by new air entering sleeve opening through roof; system is self-balancing; damper design permits simultaneous opening and closing of flue outlet and air inlet; system does not require wall openings, special ductwork, or open doors and windows.



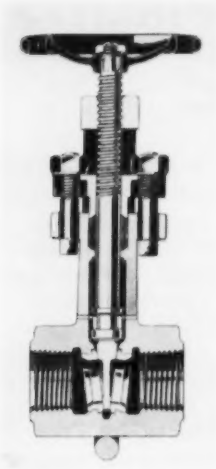
Centrifugal Blower . . .

. . .for cooling electric equipment—*American Standard Industrial Div., Detroit* 32, *Mich.*

For applications where nominal ambient temperatures can be anticipated; operates at 3000 rpm using 115 v, single phase, 60/50 cycle or 230 v, single phase, 60/50 cycle current; delivers 106 cfm of air at zero static pressure and 20 cfm of air at 1.0 in. WG static pressure.

EQUIPMENT DEVELOPMENTS

Continued



Gate Valves . . .

. . .designed to handle corrosive fluids—*Lunkenheimer Co., Waverly & Beekman Sts., Cincinnati* 14, *O.*

Available in ½ to 8 in. sizes with screwed or flanged ends; rated from 175 to 225 lb for water, oil, or gas.

Combustion Control . . .

. . .proportions process or combustion rate to load demand—*Cleveland Controls, Inc.,* 1111 *Brookpark Rd., Cleveland* 9, *O.*

Sensitivity of instrument is adjustable to accuracy of 1 percent of control set point; models for controlling steam available in standard ranges of 0 to 30, 20 to 100 and 75 to 360 psi and for controlling temperatures up to 750 F.

Water Filters . . .

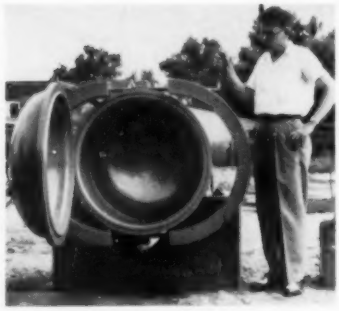
. . .for industrial process applications — *B-I-F Industries, Inc.,* 345 *Harris Ave., Providence, R. I.*

Construction is of fiber glass reinforced plastic, including filter shell; open tank construction enables inspection without disassembly; sizes range from 216 to 648 sq ft.

Duct Liner . . .

. . .with glass fiber resistance coating—*Gustin-Bacon Mfg. Co.,* 210 *W. 10th St., Kansas City, Mo.*

Duct liner conforms with all requirements of National Board of Fire Underwriters Bulletin Nos. 90-A and 90-B and other fire code requirements; permanently stamped with density and flame spread classification.



Hinged Closure . . .

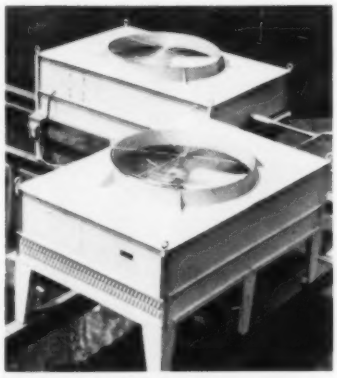
. . .featuring simplicity of design, ease of installation, according to manufacturer—*Tube Turn Plastics, Inc., Div. of Chemetron Corp.,* 2929 *Magazine St., Louisville* 11, *Ky.*

Consists of hub installed with single circumferential weld and hinged cover or cap; hinge is integral part of closure; sizes 8 in. and larger cannot be opened under high pressure.

Electronic Indicator . . .

. . .to indicate values of flow, liquid level, temperature, pH, pressure, position, input action, percents of O_2, CO_2, H_2,—*Hays Corp.,* 800 *E. 8th St., Michigan City, Ind.*

Features include 4.4 sec pointer travel over full scale with 300 deg indication and total scale length of 12¾ in.; product specification sheet "59-B721" available on request.



Air Cooled Condensers . . .

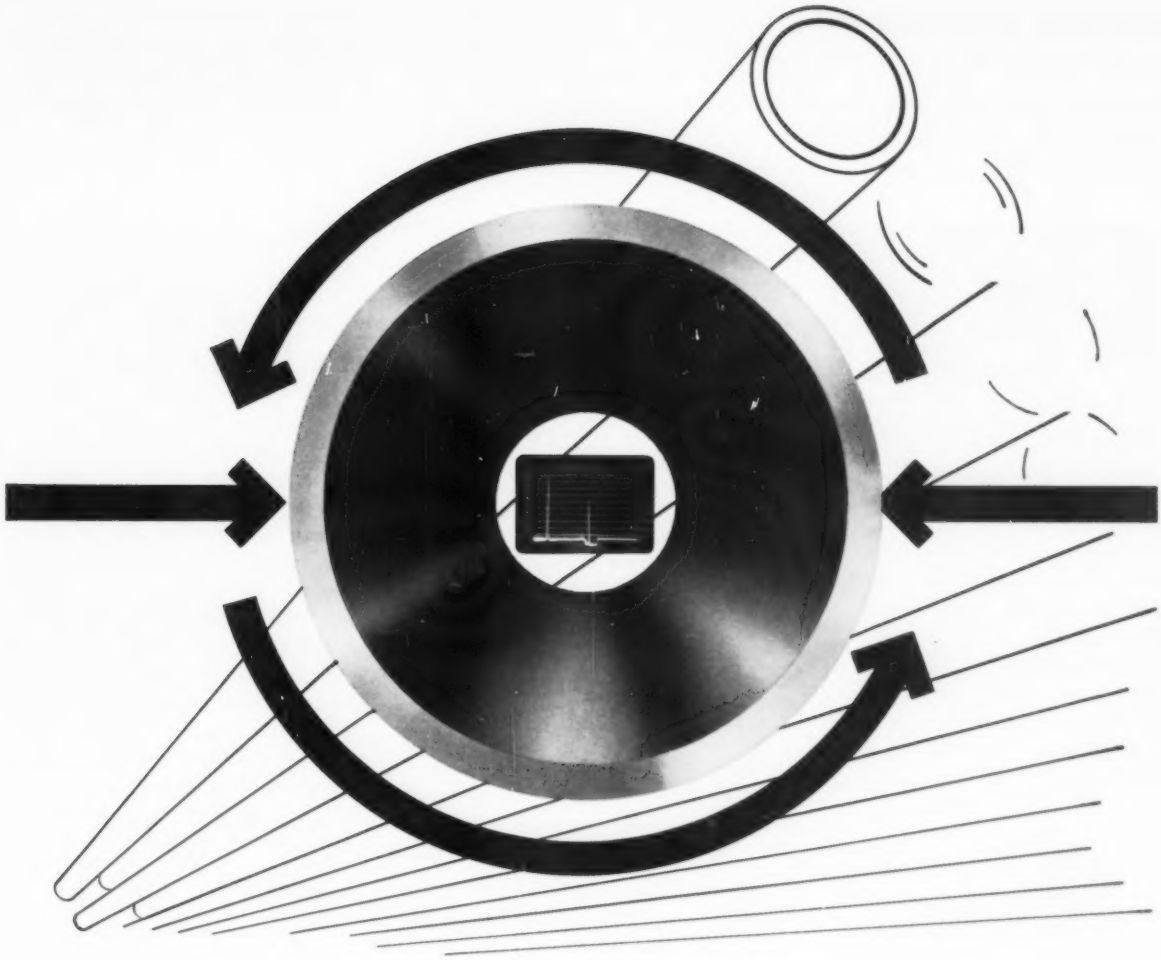
. . .in 1 to 300 ton sizes—*Halstead & Mitchell, Zelienople, Pa.*

Lower silhouettes results from horizontal mounting of fan and coils; fans are 4 blade and deep pitch, embossed fins are aluminum with die formed collars mechanically bonded to ⅝ in. OD seamless copper tubing.

Gas Fired Heater . . .

. . .for small stores, offices, and classrooms—*Carrier Corp., Syracuse* 1, *N. Y.*

With capacity of 30,000 Btu per hr; has 24 v thermostat controls and



B&W LECTROSONIC

A New Name for Carbon Steel Heat Exchanger Tubing

Dependability Proved by Five Years' Extensive Field Service

You get substantial savings with this sounder, more uniform tubing

B&W LECTROSONIC—a new name for heat exchanger tubing—is manufactured under the most exacting methods of quality control in the industry, to give you new standards of dimensional exactness and uniformity, ease of installation, and dependability—plus dollar-saving economy!

You can save on installation time. Every tube fits right and rolls in easily because it's uniform in size and tolerances. It bends easily *with the weld in any position.*

The weld is checked five ways—including 100% ultrasonic inspection—to give assurance of dependability.

This superior quality tubing was developed to meet the needs of the petrochemical industry for a dependable electric resistance welded carbon steel tube that is easily workable, strong, and less costly than seamless tubing formerly required.

B&W LECTROSONIC Tubing is available now either direct or through distributors.

Write today for B&W Bulletin TB-431 for full information—or call your nearest B&W District Sales Office. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

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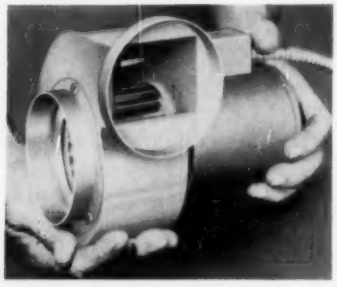
TUBULAR PRODUCTS DIVISION

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

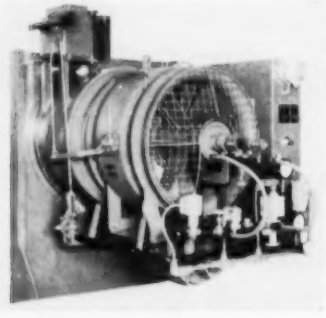
low voltage transformer as standard equipment; specifications and details in bulletin "46T98."



Vent Exhauster . . .

. . . to remove flue gases from unit heaters to outdoors through building wall—*Reznor Mfg. Co.*, 51 *Union St., Mercer* 8, *Pa.*

For heaters with 25,000 to 300,000 Btu per hr input; requires short length of 4 in. vent pipe; volume of gases exhausted controlled by built-in resistors.



Package Burner . . .

. . . integrated with axial flow, hollow shaft forced draft fan—*Faber Engineering Co.*, 240 *W. Washington St., Norristown, Pa.*

Features fuel input by wide range steam atomizing or mechanical oil burners and/or fixed ring gas burner, capacities to 50,000 lb of steam per hr; has 1750 rpm motor; descriptive catalog "59-1" available on request.

Duct Insulation . . .

. . . for wide range of temperatures — *Baldwin-Ehret-Hill, Inc.*, 500 *Breunig Ave., Trenton* 2, *N.J.*

Available in densities from 3 to 8 lb per cu ft with variety of surface facings; for temperatures from sub zero to 450 F; felt insulation available in thicknesses from 1 to 4 in. and in sizes from 24, 30, 36, or 48 in. long by 12 or 24 in. wide.

Pipe Adapter . . .

. . . increases pipe holding capacity—*Wheeler Mfg. Corp., Ross Rd., Ashtabula, O.*

Used with power drive to cut 2½ in. through 4 in. pipe; will handle pipe through 4 in. in diam for manual cutting, threading operations in conjunction with 2 in. or larger pipe vise.

Fuel Use Computer . . .

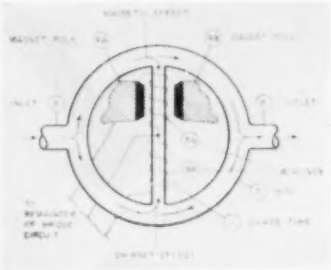
. . . for automatically recording average fuel consumption under all weather conditions — *HRB-Singer, Inc.*, 90 *Schureman St., New Brunswick, N.J.*

Key components are cylinder shaped analog, roof-top unit and recording console of portable typewriter size; roof unit is connected to recorder by way of single lead-in wire.

Integral HP Motors . . .

. . . in one to 250 hp—*Reliance Electric & Engineering Co.*, 24701 *Euclid Ave., Cleveland* 17, *O.*

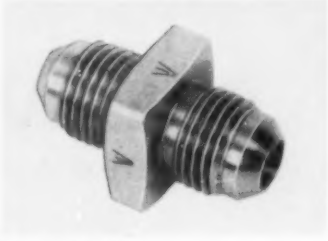
Features low inertia, fast accelerating rotor; may be specified in all standard speeds and voltages; has 40 C temperature rise, continuous duty 15 percent service factor.



Oxygen Analyzer . . .

. . . analyzes, records and/or indicates oxygen content of gas or suppressed range applications — *Hays Corp.*, 800 *E. 8th St., Michigan City* 14, *Ind.*

Where oxygen content of gas is 30 percent or less, minimum instrument span is 1 percent; where oxygen content is greater than 30 percent, minimum span is 2 percent; accuracy is ± 2 percent of scale; sensitive to changes of 0.02 percent oxygen.



Check Valve . . .

. . . for all types of hydraulic and pneumatic systems — *Quality Control Corp.*, 7315 *W. Wilson Ave., Chicago* 31.

Designed to allow full flow at operating pressures up to 3000 psi; provides quick opening and positive closing; features seal ring with dual seating action; available for ¼ to 2 in. piping connections.

Motor Blower . . .

. . . featuring automatic speed compensation for changes in internal resistance of furnace or ductwork—

AUTO AIRCON STEEL CABLE V-BELTS
from the POWER UNLIMITED complete belt line

I'M COOL MAN, COOL

The U. S. Auto AirCon Steel Cable V-Belt has everything required in a belt for air-conditioning use. Here is a V-belt that's in a class by itself. It is equipped with pulling cords of steel. A new patented curing method and electronic tensioning of the steel cords *free this belt from vibration.* It transmits power smoothly, quietly and efficiently—in present automotive air-conditioning service, lasts 1½ to 2½ times longer than any other V-belt. Here are the unequalled advantages the engineers point out:

- All steel cable members lie in the same plane.
- Wire cable members are straight, never wavy.
- Absolute uniform top width and belt thickness for better seating in pulley.
- Perfect dynamic balance.
- Use of knurled mold insert provides maximum traction and alignment of outside idler.

Our field engineers stand ready to consult with you on any or all V-belt problems. Drop us a line at address below.

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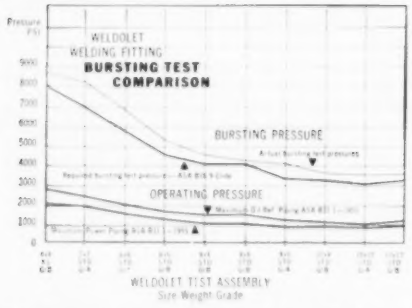
new redesigned BONNEY WELDOLETS

for reinforced branch connections on carbon steel and alloy pipe

Welding fittings manufactured and tested in accordance with ASA B16.9 and ASA B31.1

clean-cut bevel with exactly 1/16" land
bore machined with a watchmaker's precision and finish
reduced angle of bevel ... weld volume cut almost 50%
weld line clearly defined ... no more errors about "how much to weld"
skirt taper redesigned for improved stress distribution

RESULTS? OVER 4½ TIMES MAXIMUM OPERATING PRESSURE



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BRAZOLETS®
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CARBON STEEL
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ALLOY
for all services

For high strength and low-total installed cost compare with . . . other reinforced branch construction . . . unreinforced branch construction . . . and welding tee construction. Then specify and use Weldolet fittings for all full size and reducing branch connections.

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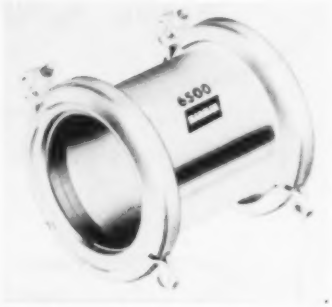
ALLENTOWN, PENNSYLVANIA

EQUIPMENT DEVELOPMENTS

Continued

Viking Air Products Div., National-U.S. Radiator Corp., 5601 Walworth Ave., Cleveland 2, O.

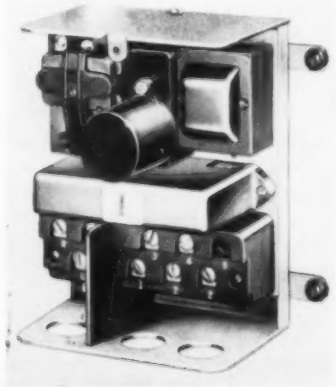
Each motor is equipped with prelubricated bearings that function for 20,000 hours without additional lubrication.



Pipe Coupling . . .

. . . for hot water lines, lube oil systems, process piping systems—*Marman Div., Aeroquip Corp., 11214 Exposition Blvd., Los Angeles 64, Calif.*

Allows up to 5 deg angular misalignment when joining pipe; permits both angular and axial pipe movement without leakage; pipe vibration and shock absorbed by gasket due to unique coupling design.



Oil Burner Control . . .

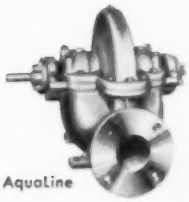
. . . for mounting in any location—*Penn Controls, Inc., Goshen, Ind.*

Consists of flame detector and combustion relay providing one stage amplification; controls available for 120 and 240 v service; bulletin "3200" available on request.

THESE QUALITY PUMPS CUT COSTLY SERVICE CALLS

PEERLESS PUMPS

PEERLESS END SUCTION AND SIDE SUCTION AIR CONDITIONING PUMPS COST LESS—LAST LONGER



Aqualine

Fluidyne

PEERLESS AQUALINE® Pumps are available in sizes to 8-inches. Capacities to 2600 gpm, heads to 280 feet. Temperatures to 250°F. Horizontal split case design allows quick inspection without disturbing piping.

PEERLESS FLUIDYNE® Pumps are compact end-suction design. Redi-Packed in 22 sizes from 1 x 2 x 6 to 2½ x 3 x 10, for immediate shipment. Heads to 230 feet, capacities to 300 gpm, motors from 1 to 15 hp.

If there is a key word to describe Peerless Pumps, that word is QUALITY. You'll find it in the way the pumps are designed. You'll find it in the way the pumps are made. And you'll find it most apparent in the way these pumps operate. Remarkably long trouble-free operating records are routine with these better-made pumps.

But QUALITY is just the start of a long list of important features that recommend the Peerless AquaLine and Fluidyne line of pumps for your water handling jobs. There's immediate availability from ready-to-ship stocks. Complete hydraulic coverage for every type of application. Compact streamlined design that gives you space-saving good-looking layouts. And fast, on-time service from a network of warehouses and field offices. Get the full story of these superior pumps. Request more information today.

ATTENTION DEALERS: A limited number of Peerless AquaLine and Fluidyne pump dealerships are available. Please write for complete information.

Putting Ideas to Work

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Offices:

New York; Detroit; Cleveland; Chicago; Indianapolis; St. Louis; San Francisco; Atlanta; Plainview; Lubbock; Phoenix; Albuquerque; Los Angeles; Fresno.

Distributors in principal cities.

Consult your telephone directory.

PEERLESS PUMP DIVISION, FOOD MACHINERY AND CHEMICAL CORPORATION
2005 Northwestern Avenue, Indianapolis 8, Indiana

Gentlemen: Please send me immediately:

- ☐ Bulletin B-2319 on Peerless Fluidyne Pumps.
- ☐ Bulletin B-2100 on Peerless Aqualine Pumps.
- ☐ Name and address of nearest Peerless Dealer.

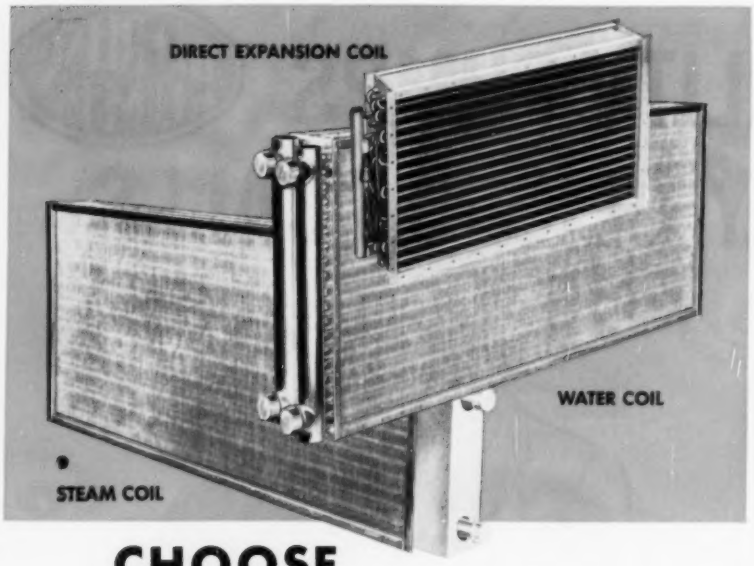
Name_____

Address_____

City_____

State_____

HPAC



CHOOSE BOHN KNOWN-CAPACITY COILS

ALL BOHN COILS are ruggedly built . . .

- Die-formed plate-type aluminum fins . . . from 4 to 14 per inch . . . with self-spacing collars completely covering the tubes. Permanent, tight, metal-to-metal fin-tube bond.
- Heavy-gauge casings die-formed from galvanized steel.
- Headers of heavy-wall seamless copper tube with heavy die-formed end caps. High pressure tested at 320 psig. minimum air pressure under warm water.
- Tested and rated according to ASRE-ASHAE standard 33-58.

IN ADDITION . . .

DIRECT EXPANSION COIL (1), Type DE, insures equal distribution of refrigerant with brass pressure-type distributors;

WATER COIL (2), in Types WH, WF, and WD, is drainable in every type;

STEAM COIL (3), in Types S, NFS, and NFO, has condensing tubes pitched in casing a minimum of ⅛" per foot of tube length, as well as orificed steam supply tubes, and coil tubes floating free within coil casing to prevent stress and strain on tubes and joints . . . maximum operating pressure 200 psig. at 400° F.

"Buddy Bohn" reminds you:

"We are one of the largest manufacturers of specially designed evaporators and condensers for Original Equipment Manufacturers of refrigeration and air conditioning units and systems."

For full information, call or write to Bohn

BOHN *Buy the known line . . . the BOHN line*

Aluminum and Brass Corporation

Danville Division, Danville, Illinois

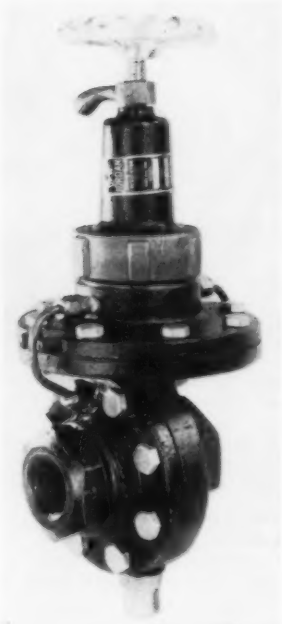
EQUIPMENT DEVELOPMENTS

Continued

Air Sampling Kit . . .

. . . to collect dusts, radio-active aerosols, and gases—*Gelman Instrument Co., Box 86, Chelsea, Mich.*

Combines vacuum pump, flowmeter and weatherproof housing; choice of 2 or 4 cfm capacity available; special filters and filter holders also available.



Back Pressure Regulator . .

. . . for use wherever accurate control and tight shut-off are required—*OPW-Jordan, 6013 Wiehe Rd., Cincinnati 13, O.*

Suitable for pressures to 250 psi and temperatures to 500 F; available in ductile iron or bronze from ½ to 2 in. sizes; controls 50 to

TOUGH BUYERS DEMAND REZNOR FIVE-WAY HEATERS

to project heat where needed on "difficult" jobs... with no waste!

When cranes, production machinery or huge inventory stacks require abnormally high heater placement, you *have* to be a "tough buyer" to do a proper heating job! You have to deliver a unit that will project heat where it's needed . . . with no waste of fuel *or* heat. That's why so many heating contractors now demand the new Reznor Five-Way Heater, which projects heat downward, even from a height of 40 feet, to the spot where heat is needed, and (with the optional 5-way diffuser) in as many as five directions at once!

LOWER FUEL COSTS—By spotting heat accurately, the Five-Way Heater maintains complete comfort with less fuel; keeps fuel bills low.

LOWER INSTALLATION COSTS—The entire assembly installs quickly, requiring only gas, flue and power connections.

Available with aluminized or stainless steel heating elements and gas modulation. Electric ignition is optional.

For information, phone your Reznor distributor, or write Reznor Manufacturing Co., Dept. 51C, Mercer, Pa.

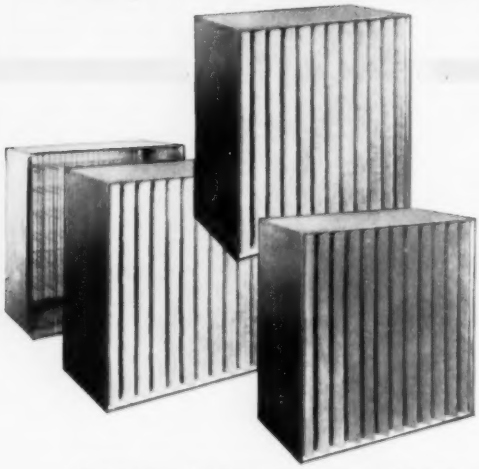
The heating world is full of tough buyers; that's why Reznor is the world's largest selling direct-fired heater!

REZNOR HEATERS

"THE TOUGH BUYERS' LINE"

The Cambridge AEROSOLVE® Filter is the RELIABLE Filter

- High Efficiency
- Positive Filtration
- Low Pressure Drop
- Easy Installation & Maintenance
- High Velocity — 450 FPM
- Expert Technical Assistance



AEROSOLVE Filter Cartridges, all interchangeable, are available in efficiencies of 95%, 85%, and 35%, NBS test method with atmospheric dust.

Lowest Pressure Drop of Any Positive High-Efficiency Filter

TO BE SPECIFIC:

	AEROSOLVE 95	AEROSOLVE 85	AEROSOLVE 35
Average Discoloration Efficiency (N.B.S. Dust Spot Method)	95%	85%	35%
Static Pressure (250 fpm Models)	0.35" w.g.	0.22" w.g.	0.16" w.g.
Static Pressure (450 fpm Models)	0.45" w.g.	0.32" w.g.	0.25" w.g.

Minimum net filter area of 43 sq. ft. per 1000 CFM provides long life which, with low initial investment, guarantees economical owning and operating costs.

Write for Bulletin 132

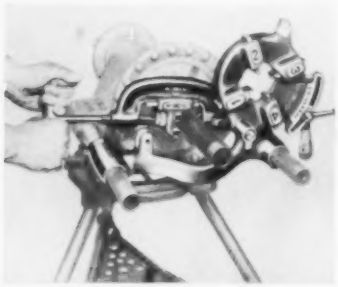
Cambridge® Filter Corporation
732 E. Erie Blvd., Syracuse 1, N. Y.

Pioneers in High Efficiency Air Cleaning

REPRESENTATIVES IN PRINCIPAL CITIES

EQUIPMENT DEVELOPMENTS
Continued

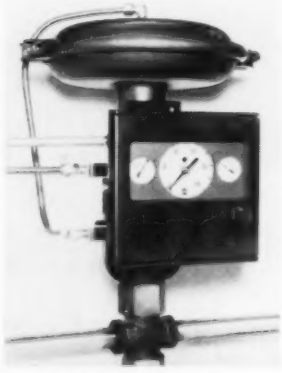
6600 lb steam per hr or 7 to 190 gal of water per min; bulletins "JNP-3" and SRBC "51-59" give complete engineering information.



Pipe Threading Machine...

...for use on portable power drive —*Ridge Tool Co., Clark St., Elyria, O.*

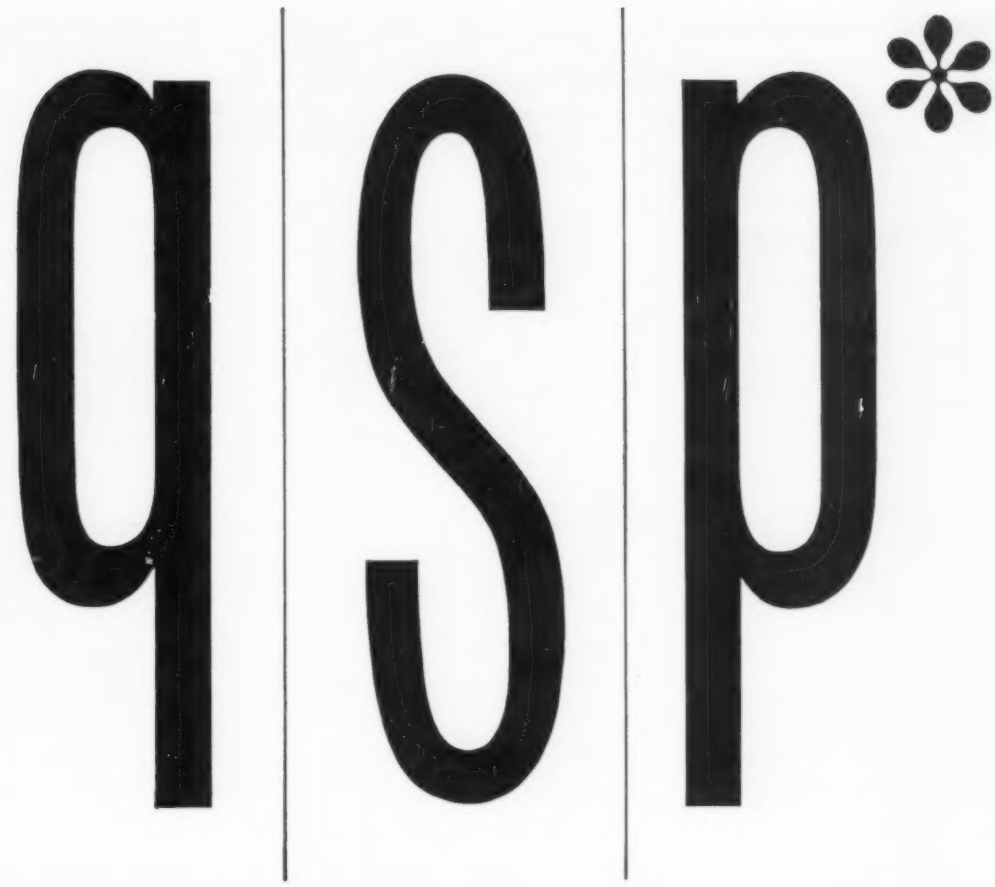
Consists of carriage which slips on support arms of power drive and holds die head and cutter like piping machine; cutter features wide rolls for straight cuts at pipe machine speed; carriage accommodates pipe or bolt dies.



Valve Positioner...

...for use in process and power industries—*U.S. Gauge Div. of American Machine and Metals, Inc., Sellersville, Pa.*

Pressure elements cover range of 30 in. Hg vacuum to 10,000 psi; filled-system thermometer elements cover range of −350 to 1000 F; control modes available are proportional or two-position with differential gap, both adjustable from 0 to 75 percent.



*Westinghouse q|s|p means quality-service-performance

. . . in products, services and programs offered to the customers of Westinghouse air conditioning and heating. q|s|p is more than a slogan. It's a pledge and a reality to those who sell and to those who buy Westinghouse products.

Quality in products—in the sales, training and promotion programs that Westinghouse provides; in the caliber of people with whom you deal; in the job Westinghouse contractors perform in installing and servicing equipment.

Service of the whole Westinghouse organization in helping contractors sell more, more profitably; the extra service given by the Westinghouse contractor and dealer to their customers; customer service, order service, replacement service and all the many others offered by Westinghouse.

Performance in every phase of business that helps your association with Westinghouse be a profitable one; performance of products in use; performance of people who are vitally interested in your needs and your customers; performance of the most modern, complete air conditioning plant in the world, manned by the most experienced workers in the industry; *performance of a full range of packaged and field-assembled equipment for all three markets—residential, commercial and industrial.*

In the months to come, you will see the graphic evidences of how Westinghouse q|s|p has built profits and reputations for the leading contractors in this industry. You will see how q|s|p becomes a powerful sales weapon for all who share the identity of Westinghouse Heating and Air Conditioning Specialists.

Westinghouse q|s|p has real meaning for contractors, specifiers and users. On your next air conditioning or heating requirement, better call Westinghouse.

J-85025-A

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV FRIDAYS

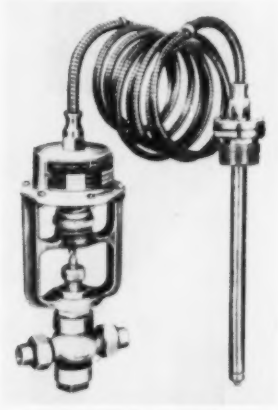
AIR CONDITIONING DIVISION, WESTINGHOUSE ELECTRIC CORPORATION, STAUNTON, VIRGINIA

EQUIPMENT DEVELOPMENTS
Continued

Filter-Drier . . .

. . . for protection against acids, moisture, and dirt—*Controls Co. of America, Heating and Air Conditioning Controls Div., Milwaukee, Wis.*

Combined strainer, filter, and drier features blend of silica gel and desiccants; removes particles as small as 5 microns; offered with solder or flare type connections; 1/3 to 7½ ton capacities.



Temperature Regulators . .

. . . designed to control flow of heating or cooling fluids—*A. W. Cash Valve Mfg. Corp., P.O. Box* 191, *Decatur, Ill.*

Used on water heaters, fuel oil preheaters, fuel oil coolers and storage tanks; available with bronze bodies from ¼ to 2 in. with union connections with 125 lb ASA flanged ends; capillary tubing, cable, temperature bulbs and wells offered in various metals; information, including capacities in bulletin "7-1" available on request.

Tubing Joint . . .

. . . offers solution to problem of limited clearance—*Jones & Laughlin*

Another CAINS COIL OF PROFIT

PRE-FAB-RIC

A PREFABRICATED FLEXIBLE DUCT CONNECTION

Simply pull out desired length from dispenser-type carton. (It pulls out ready to use.) Roll into round duct or form into square duct and join. Saves 70% time over old methods. DOUBLE-SAFE-LOCKED

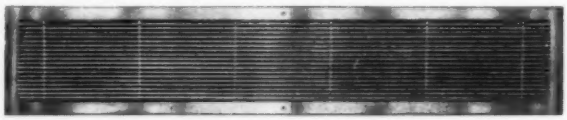
A TYPE, SIZE, AND PRICE FOR ALL JOBS

THREE GRADES: Commercial - Economy - Residential

THREE FABRICS: Canvas - Asbestos - Neoprene

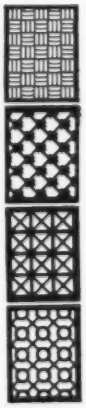
Union Made

CAIN MANUFACTURING, INC.
Birmingham, Alabama
1111 North 5th Ave., Phone FA 2-0354



DIAMOND GRILLES
For Modern Public Buildings

When you need grilles that retain their original attractive appearance indefinitely — against any probable amount of rough treatment — you'll be starting right by sending for our latest bulletins. They show designs developed during nearly half a century of successful experience.



Bulletin 41 illustrates and describes Diamond Architectural Grilles; stamped from any commercial metal in a wide variety of artistic designs; in any desired thickness up to one-fourth inch.

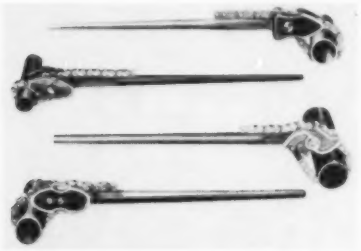
Bulletin 43 illustrates and describes Diamond Fabricated Grilles; heavy-duty bar-type grilles designed and built to give the best possible combination of enduring strength and high open area.

Both bulletins will be mailed promptly on request without charge or obligation

DIAMOND MANUFACTURING CO.
Box 40 WYOMING (Wilkes-Barre Area) PENNA.

Steel Corp., 3 Gateway Center, Pittsburgh 30, Pa.

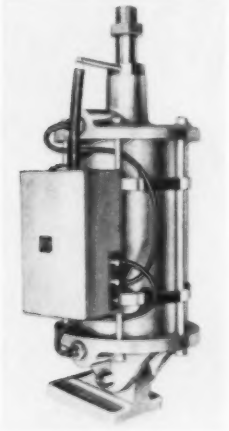
Coupling is machined down to outside diam of 2¾ in. which is 5/16 in. smaller than API threaded and coupled external upset tubing.



Pipe Tongs . . .

. . .equipped with heat treated flat link chains—*J. H. Williams & Co., 400 Vulcan St., Buffalo 7, N.Y.*

Flat links made from selected steel; rivets and swing chain of alloy steel, all chains heat-treated after assembly and proof tested to 2/3 of breaking strain.



Damper Motor . . .

. . .to control vortex dampers, inlet valves of compressors and large dampers — *Powers Regulator Co., 3434 Oakton St., Skokie, Ill.*

Motor has torque rating of 150 ft lb based on 20 psi air supply, crank radius of 5 in. and 90 deg travel; gradually controls 200 sq ft of damper area up to 1200 fpm velocity; bulletin "P-81" containing additional information available on request.

Life in these excited states...

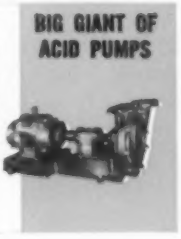
"Have you seen the pipe inspector?"

How Ace keeps you out of the tight spots

We admire men who jump right into the tough problems, but our business is eliminating problems completely. That is, problems of corrosion and contamination in piping, valves, pumps, tanks, and the like. Good equipment keeps you always in the clear. Our 108 years of experience is at your service.

Ace chemical-resistant rubber-lined steel pipe best for high-pressure, big sizes, or abrasives. Pipe, fittings and valves 1½ to 24".

Highly efficient *WE* pump. Capacity to 360 gpm. Cast iron, fully protected by top quality, chemical resistant hard rubber lining.



Design assistance and facilities for molding special fittings, pump parts, etc., of plastics or hard rubber. Also large hand-fabricating facilities.

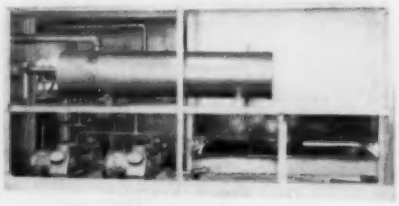
Variety and quality to match *any* plastic piping. Riviclor PVC, Ace-Ite rubber-plastic, Parian poly, Ace Saran, Tempron high temperature nitrile, hard rubber-lined steel.

ACE processing equipment of rubber and plastics

AMERICAN HARD RUBBER COMPANY
DIVISION OF AMERACE CORPORATION
Ace Road • Butler, New Jersey

EQUIPMENT DEVELOPMENTS

Continued



Water Chiller . . .

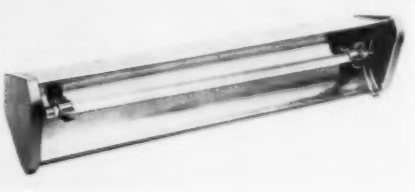
. . . in 12 basic models from 15 to 120 tons—*Governair Corp., 4846 N. Sewell, Oklahoma City, Okla.*

Completely self-contained with all components, including evaporative condenser in one cabinet.

Air Conditioning Controls . . .

. . . engineered to handle variety of commercial applications — *Ranco, Inc., 601 W. Fifth Ave., Columbus 1, O.*

Controls handle one, two and three-phase overload protected motors of ½ through 5 hp capacity; electrical ratings for single-phase connections and 120 v. a-c are from 12 amps full load, 72 amps locked rotor — to 24 amps full load, 144 amps locked rotor.



Infrared Heater . . .

. . . designed to be mounted side by side, or end to end —*N.J. Thermex Co., Inc., 533 Bergen St., Harrison, N.J.*

Operates in spectrum of intermediate infrared radiant wave length of 1.7 to 3 microns with peak of 2.2 microns.

YOUR IDEAS WORK BETTER WHEN YOU WORK WITH HONEYWELL

THE FOLLOWING pages bring you some of the latest developments in automatic controls from Honeywell. They widen your choice of products; give you more to work with.

For complete information on these new control products and systems, call your nearest Honeywell sales office. Honeywell provides 112 sales offices throughout the country. Each is staffed with control specialists to assist you in writing specifications and preparing control layouts.

Now! A master control for your central fan system—

New Honeywell Transistorized control combi

Five adjustment knobs give you finger-tip control of duct temperature from one location

- Adjustment for throttling range of controlling thermostat
- Factory calibration adjustment knob
- Adjustment for outdoor air thermostat effect
- Adjustment for second thermostat effect
- Adjustment for calibration and control point

The following additional features offer you extra protection, extra convenience: rugged mounting case made of 16-gauge steel, reinforced top and bottom; hinged, swing-out panel for easier servicing; easy-to-read terminal connections that reduce chances of wiring errors; separate terminal strip for panel power; ample number of knockouts (seven at top, seven at bottom) for easier installation.

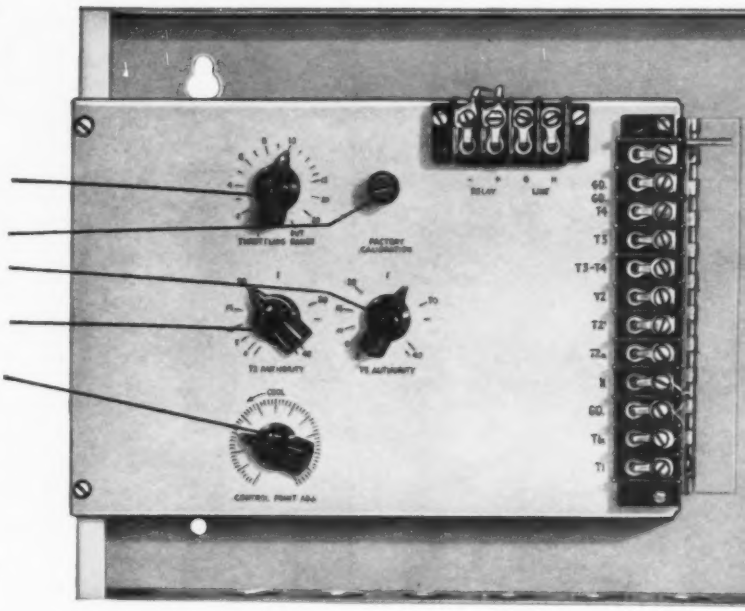
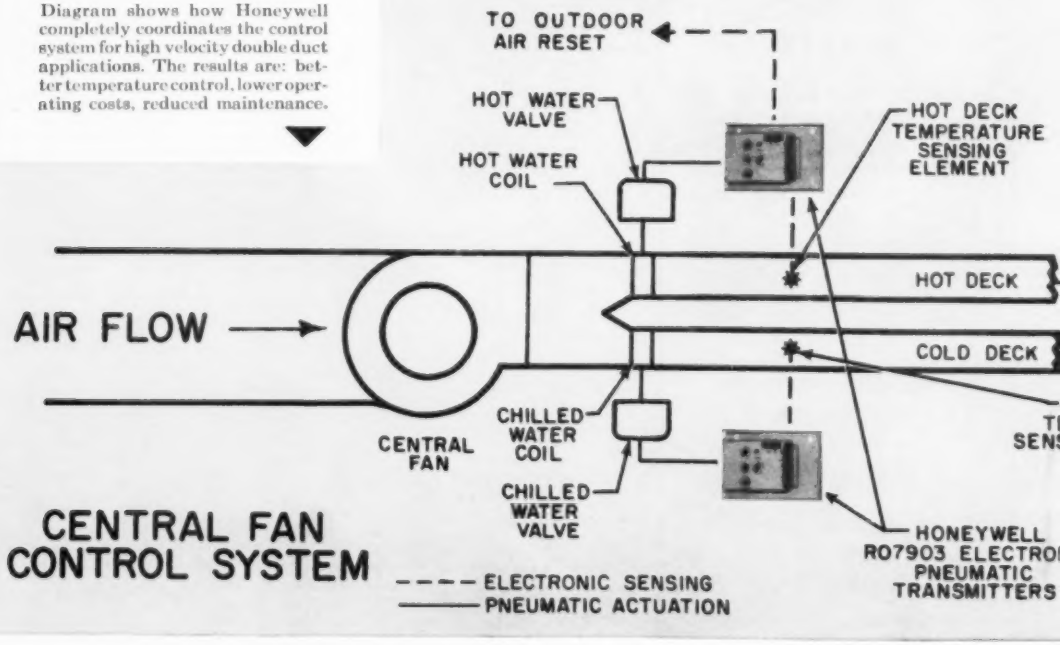


Diagram shows how Honeywell completely coordinates the control system for high velocity double duct applications. The results are: better temperature control, lower operating costs, reduced maintenance.



ıbines the best of electronics and pneumatics!

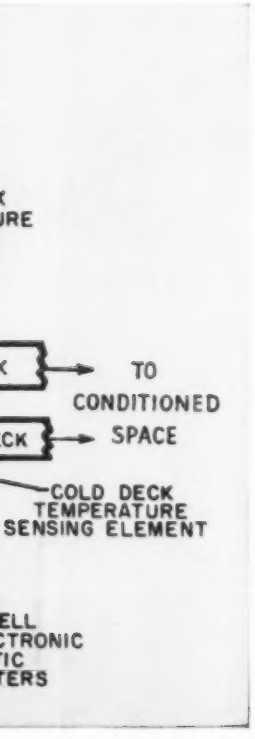
This new relay combines the sensitivity and versatility of electronic sensing with the powerful, rugged economy of pneumatic actuation—your assurance of better control performance!

Now you can completely co-ordinate the control of your air conditioning system from a single location! The new Honeywell Electronic-Pneumatic Transmitter eliminates difficult, inexact adjustments at sensor locations—and, there's a free choice of locations because sensors are now adjusted at the central panel.

This new relay combines the sensitivity, freedom from ambient temperature effect, fast response and versatility of *electronic sensing* with the powerful, rugged economy of *pneumatic actuation*. It's the perfect combination of functional advantages needed to do a better control job for you.

Two compact, rugged transistors handle the R07903's power load with plenty to spare—your assurance of trouble-free performance and longer life.

Honeywell's new Electronic-Pneumatic Transmitter offers you a choice of specialized sensing elements as shown below. For more information about the many ways the R07903 can serve you, call your nearest Honeywell office today or write Minneapolis-Honeywell, Dept. AC-11-141, Minneapolis 8, Minnesota.



Honeywell offers you a wide choice of specialized sensing elements for use with the R07903 transmitter!

These elements have no moving parts, require no adjustments and provide faster, more accurate response. They are simple coils of temperature sensitive wire—dustproof, tamperproof, foolproof—that insure your systems long years of dependable, trouble-free service.

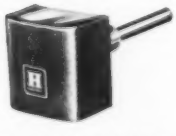
Relay connections are made with simple, standard low-voltage wiring, and can be manufactured in various shapes and sizes for easy fitting to each individual installation. Element lengths for duct measurements vary from 4 inches to a special averaging model of 27 feet.

INSERTION ELEMENTS

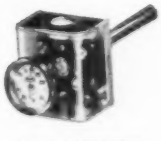
DUCT ELEMENTS

OUTDOOR ELEMENT

AVERAGING DUCT ELEMENT



INSERTION ELEMENT



DUCT ELEMENT

DUAL-ACTING DISCHARGE ELEMENT

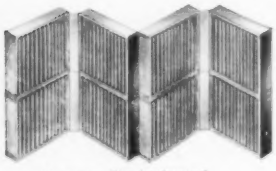
NOW! FLUTTER-JET WASHING
Another first for Honeywell's
ELECTRONIC AIR CLEANER

Actual unretouched strobelight photograph taken at 1/2,000 second.

Never before such a quick, efficient way to wash electronic air cleaners! Honeywell's new flutter jet washer literally *blasts* water throughout the air cleaner, with a fluttering, sweeping action that flushes away accumulated dirt quickly—cleans every part thoroughly. The new flutter jet nozzle never clogs.

Honeywell's Electronic Air Cleaner
Removes 90% of all airborne dirt

Honeywell's Electronic Air Cleaner



Honeywell's Activated Charcoal Filter

You can now select from three types of cells: (1) *Hi Velocity*—where space is limited. (2) *Standard*—for normal conditions, provides high efficiency dirt removal and high dirt capacity. (3) *Hi Load* for handling high dirt concentration.

With these 3 different cell capacities, you can have complete freedom in designing your plenums. Just select the cell type and number of cells that will give you the air cleaning capacity you need in the plenum space available. No longer is it necessary to design your plenum to fit the air cleaner.

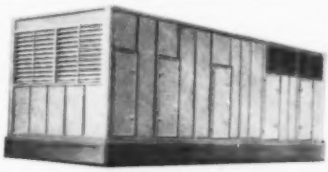
Remove Odors, Too

For the ultimate in air cleaning, team up Honeywell's Electronic Air Cleaner with the Activated Charcoal Filter—for removal of *odors and gases*, too. Only Honeywell offers this *exclusive* combination.

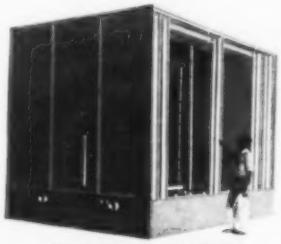
For more information about Honeywell air cleaning, call your nearest Honeywell office. Or write: Minneapolis-Honeywell, Dept. AC-11-141, Minneapolis 8, Minn.

Honeywell

H HONEYWELL First in Control



ARTICULATED AIR CONDITIONING UNITS



SPRAY TYPE AIR WASHERS

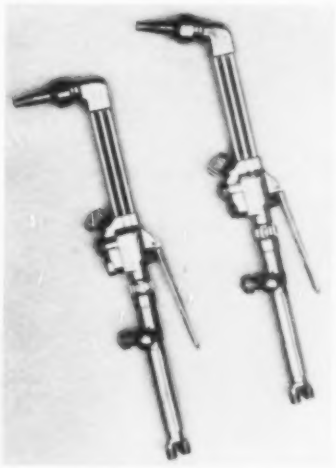
CAPILLARY® AIR WASHERS

A&R

PRODUCTS
For Air Conditioning
Write for catalog
To —
AIR & REFRIGERATION CORPORATION
439 MADISON AVENUE
NEW YORK 22, N. Y.
®TRADEMARK REG.

EQUIPMENT DEVELOPMENTS

Continued



Cutting Assembly . . .

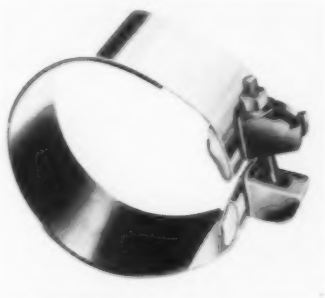
. . . for steel up to 11/2 in. — *Smith Welding Equipment Corp.*, 2619 *Fourth St., N.E., Minneapolis* 11, *Minn.*

Unit may have 75 or 90 deg head; both models are 8 3/4 in. long (excluding lever) and weigh 17 3/4 oz.

Magnetic Starter . . .

. . . rated at 15 hp, 440-550 v—*Furna Electric Co.*, 1041 *McKee St., Batavia, Ill.*

Features front removable components, dual voltage coils reconnectable on the job; "trip-free" thermal overload relays with trip indicator; catalog "14-B1" available on request.



Pipe Repair Clamps . . .

. . . for pipe sizes from 1/2 to 8 in. in 3, 6, 9, 12 in. widths—*Marman Div. of Aeroquip Corp.*, 11214 *Exposition Blvd., Los Angeles* 64, *Calif.*

Lug design allows pipe repair clamp to conform to contours of pipe without biting into pipe; repair pad will withstand high clamping pressures without extruding.

Fire Damper . . .

. . . approved and labeled by Underwriters' Laboratories, Inc., and Board of Standards and Appeals of New York City—*Imperial Damper Co., 664 Edgecombe Ave., New York* 32.

Damper capable of resisting 1790 F for 90 min as determined through tests; according to manufacturer.

Equipment Briefs . . .

COMBUSTION INDICATOR showing changes in fuel or air adjustment — *Photomation, Inc., 96 S. Washington Ave., Bergenfield, N.J.* Panel instrument gages equipped with lights to indicate required adjustments; also available in models that give records of performance.

TORQUE INDICATOR to measure torque of rotating shafts — *Metron Instrument Co., 432 Lincoln Ave., Denver 3, Col.* Available in ranges covering torques from 0.1 oz-in. to 500 oz-in.; provides accuracy of —2 percent of full scale; torque readings independent of shaft speeds between 50 and 24,000 rpm; may be used with recorders.

PLASTIC WELDING equipment changes including adoption of universal nozzles — *Laramy Products Co., 90 South St., Hingham, Mass.* Neoprene air hoses replacing rubber and new barrel design facilitating cleaning have been installed; descriptive literature available on request.

GAS CONTAINER to handle working pressures up to 1750 psi — *Tube Manifold Corp., 415 Bryant St., North Tonawanda, N.Y.* Uses include; aerosol, fire extinguisher, oxygen resuscitation, insecticide; adaptable to spray valve, nozzle, oxygen mask, fire extinguisher and other operating fittings. ‡

They compared efficiency, permanence, and applied cost ...and bought ULTRALITE®

FOR INFORMATION AND DELIVERY, CALL YOUR LOCAL ULTRALITE DISTRIBUTOR (LISTED IN THE YELLOW PAGES.)

COMPARE APPLIED COSTS... and you, too will discover the economy and ease of installing ULTRALITE, the *only* duct insulation made exclusively of long, textile-type glass fibers. ULTRALITE'S long-staple strength assures more resilience . . . less likelihood of damage, both during and after installation . . . more uniform thickness for full insulating efficiency and a neater job. *Compare* . . . and you'll also find that ULTRALITE is outstanding in thermal and acoustical efficiency. For many of the same reasons, you'll want to try ULTRALITE glass fiber *duct liner*, too.

If you're interested in top performance at rock-bottom costs, next time use ULTRALITE, the only lightweight, low-density glass fiber insulation with a 12-year record of performance. You'll find it readily available in all major cities from local distributor stocks, plain or with a variety of factory-adhered facings that enhance appearance and prevent moisture penetration.

GUSTIN-BACON *Manufacturing Co.*

220 W. 10th St., Kansas City, Mo.

Two 30-hp Monitor boilers at an eastern laundry replaced older boilers. Owner estimates Monitor boiler efficiency will pay for cost in three years.

Here's big performance from a small package

Cleaver-Brooks Monitor boilers are compact sources for dry steam — more of it at less cost means more profitable plant operation

Whatever your need for dry steam, Monitor packaged boiler will slash your costs, speed your operations. By any test, Monitor boiler is a practical investment in working steam.

Take fuel economy, for example. High fuel-to-steam efficiency — guaranteed at 80% minimum — can save your plant hundreds of dollars over boilers just 10% lower in efficiency. Monitor boiler is designed to the standards of larger industrial boilers to provide excellent heat transfer, high combustion efficiency, proper air-fuel ratios.

You'll find 99% dry, working steam, ready response, and ample steam reserve make Monitor boiler a real workhorse for any job.

Factory tested, delivered as a complete package, ready to operate.

Available in sizes 15-60 hp, 150 psi, oil, gas and combination oil/gas fired. For the complete Monitor story, contact your representative or write Cleaver-Brooks Company, Dept. M, 313 E. Keefe Ave., Milwaukee 12, Wisconsin.

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ORIGINATORS AND LARGEST PRODUCER OF PACKAGED BOILERS

RECENT TRADE LITERATURE

▸ *ADJUSTABLE SPEED DRIVE* — bulletin "3660" includes design features of drives operating in a-c power in speed ranges up to 8:1; available in ratings from 1 to 30 hp; also includes engineering and application information. *Louis Allis Co.*, 427 *E. Stewart St., Milwaukee* 1, *Wis.*

▸ *ADJUSTABLE SPEED DRIVES* —from ⅛ to 4 hp; bulletin "D-2507" contains condensed specifications, dimensions, and gearmotor selection table. *Reliance Electric and Engineering Co.*, 24701 *Euclid Ave., Cleveland* 17.

▸ *AIR COMPRESSORS*—in ¼ to 20 hp range described in catalog "36A"; contains question and answer section regarding air compressor theory along with selection data charts; specification sheet is bound into catalog. *Brunner Div., Dunham-Bush, Inc.*, 179 *South St., West Hartford* 10, *Conn.*

▸ *AIR CONDITIONING*—catalog "82" discusses full range of accessories and tools used in maintenance or installation jobs; line of flared and compression fittings completely listed. *Imperial Brass Mfg. Co.*, 6300 *W. Howard St., Chicago* 48.

▸ *AIR CONDITIONING BATTERIES*—for railway passenger cars; new booklet discusses procedures needed to keep batteries operating, from battery fundamentals, through installation, charging, inspection, and records. *Electric Storage Battery Co., Exide Industrial Div., Rising Sun and Adams Aves., Philadelphia* 20, *Pa.*

▸ *AIR SAMPLING TECHNIQUES* —to determine amount and size distribution of airborne dusts discussed in manual No. "2." *Gelman Instrument Co., Chelsea, Mich.*

Still no sign of wear or corrosion in Patterson-Kelley storage water heater

AFTER 26 YEARS OPERATION

Credit Revere Copper for this outstanding performance

The copper-lined heater you see above was installed in the Bronx County Courthouse Building, New York City, in 1932, and processes rust-free hot water for the 1,000 staff members and more than 5,000 visitors daily.

Department engineers inspected the heater annually, the last inspection being in June, 1958. At that time the above photo was taken of the heater's interior. After 26 years constant use, processing over 8,500,000 gals. of water at the average rate of 4 tons per day, the heater was found to be in excellent condition, all original fittings in good operating condition and copper tube bundles and supports showed not one sign of wear or corrosion. Once again copper has proved a most efficient, economical and durable material in storage water heater service.

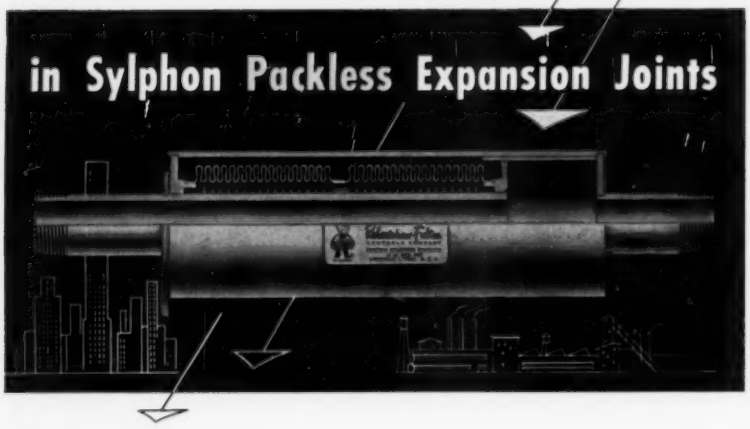
Find out how copper and its alloys can help you in your corrosion problems, whether it be storage water heaters, heat exchangers, condensers or distillation units. Call on Revere's Technical Advisory Service with its great storehouse of knowledge on this subject.

REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801
Executive Offices:
230 Park Avenue, New York 17, N. Y.

Mills: Rome, N. Y.; Baltimore, Md., Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities. Distributors Everywhere.

NOW...PIPE SIZES UP TO 6"



- Externally Shielded
- Internally Guided
- Full Two-Inch Traverse
- 150 Lbs. Working Pressure

Broader pipeline service for schools, institutions, office buildings, plants! Our ruggedly built 1291 Packless Expansion Joint is now available from ¾" to 6" pipe sizes for horizontal or vertical pipe lines—either water or steam.

Built around the famous Sylphon® Bellows of multi-ply stainless steel, this hard-working, trouble-saving joint is externally shielded and internally guided—yet comes to you reasonably priced and completely assembled, ready for immediate installation and lifetime service.

Choose from a complete range of Sylphon Packless Expansion Joints, with bellows of monel, copper or stainless steel. No packing problems, no costly repairs . . . surveys show less than 2% replacement after 25 years' service!

Get the Facts on Packless . . . in Catalog F-VH

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RECENT TRADE LITERATURE

Continued

▸ *ALLOY TUBING*—advantages discussed in new folder "TB-430"; includes details of structural advantages, fabrication, types of steel, types of tubes. *Babcock & Wilcox Co., Tubular Products Div.*, 712 *Eleventh St., Beaver Falls, Pa.*

▸ *ALUMINUM TUBE*—information in new book details selection of proper tube alloys, temper designations for aluminum tube and resistance of alloys to various chemicals; contains tables of typical properties and property limits of aluminum tube, standard tolerances for all types of tube and pipe, and weights per ft of aluminum tubes in various alloys. *Revere Copper & Brass, Inc.*, 230 *Park Ave., New York* 17.

▸ *AUTOMATIC SOLDERING*—new guide includes data on range of preform shapes, alloys from which they are made and their uses; describes heating methods, flux selection, metals characteristics, and alloy selection; provides temperature conversion chart and solder reference data. *Alloys Unlimited, Inc.*, 21-01 *43rd St., Long Island City*, 1, *N.Y.*

▸ *AUTOMATIC CONTROLS*—catalog contains description, applications, and full specifications for each product listed. *White Rodgers Co.*, 1209 *Cass Ave., St. Louis* 6, *Mo.*

▸ *BLOWER UNITS*—dimensional and performance specifications on two unit series contained in bulletins "DD-154" and "DD-173"; bulletins contain full performance curves giving variations in static pressure, speed, power, and current with air flow rate for 4 blower models in each of two wheel diameter sizes. *Air Impeller Div., The Torrington Mfg. Co., Torrington, Conn.*

Anywhere you need 'em . . .

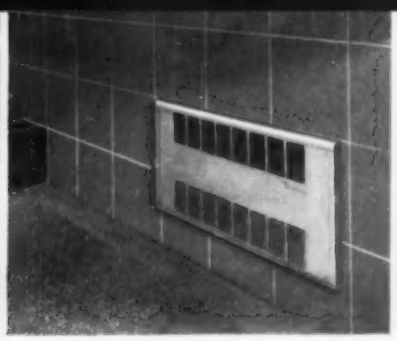
WALLS
Units in this gym are inverted on walls to keep floor area clear.

FLOORS
This unit in hotel guest room is equipped to heat, cool, ventilate.

CEILINGS
Control room gets its comfort from out-of-the-way unit on ceiling.

Any way you want 'em . . .

EXPOSED
Unit in bank lobby blankets doorways with curtain of heated air.



RECESSED
Blending with attractive decor, recessed unit warms entrance hall.

CONCEALED
Only inlet and outlet grilles show in this office building lobby.

MODINE cabinet units heat and ventilate to perfection

RECESSING IS FAST AND NEAT WITH MODINE'S PERMA-LAP®

Perma-lap framing ends muss and fuss of full or partial recessing of cabinet units. Ends wall streaking due to air leakage, permits removal of unit front without disturbing wall seal, eliminates problems caused by uneven wall surfaces.

The versatility of Modine cabinet units is practically unlimited. You can install them upright or inverted . . . freestanding, recessed or concealed . . . on floors, walls, ceilings . . . with or without filters. Some models heat with steam or hot water, others heat with hot water, cool with chilled water. Some can be installed with ducts. And easily attached accessories permit ventilation with outside air.

Modine offers eight distinct types — all attractively styled, compact, easy to install and with the most efficient heating elements for maximum heating economy.

C-1401

FOR ALL THE FACTS *on Modine cabinet units, call the Modine representative listed in the yellow pages of your phone book. Or write for Catalog 557 to Modine Manufacturing Co., 1509 DeKoven Ave., Racine, Wis.*

In Canada: Sarco Canada, Ltd., Toronto 8, Ontario

Modine®
MANUFACTURING COMPANY

RECENT TRADE LITERATURE

Continued

▶ *BOILER BID FORM*—in tabular form; contains 15 comparative items under "Boiler & Trim" listing, 20 items under "Burner & Controls", 14 items under section for insertion of installation labor and material costs. *Boiler Engineering & Supply Co., Inc., Manavon St., Phoenixville, Pa.*

▶ *BOILER WATER CONTROL*—systems for steam boilers described in brochure "34-B-1"; includes specification table, design and construction features, functions of system to keep water free of sludge and suspended solids. *Sparkler-Filtrion Corp., Dept. AA1, 24th and Commonwealth Ave., North Chicago, Ill.*

▶ *BRANCH FITTINGS*—for pipe described in catalog "TF-1-59"; includes design information, sizes material specifications, special features of each fitting. *H. K. Porter Co., Inc., W-S Fittings Works, P.O. Box 95, Roselle, N.J.*

▶ *CENTRIFUGAL FANS*—with backward inclined blades presented in bulletin "1500" giving engineering and construction features; bulletin contains 27 pages of capacity charts for each model of two lines of fans. *Century Fan & Ventilator Co., Inc., 45 Cedar St., Stamford, Conn.*

▶ *COMBUSTION CHAMBER REPAIR*—booklet describes new furnace lining; contains installation instructions and technical data as well as photos illustrating installation procedures. *Socony Mobil Oil Co., 150 E. 42nd St., New York 17.*

▶ *COMPRESSED AIR*—fundamentals in new booklet "1548" contains tabular and chart information on cu ft of air required to operate pneumatic equipment; also has data on dimensions of compressors and tables on ratios of compression and flow of air through orifices. *Ingersoll-Rand Co., 11 Broadway, New York 4.*

▶ *CONDENSERS, CHILLERS*—described in catalog "300B" containing capacities, dimensions, heat transfer data, and other engineering information; system-engineered components of each fully discussed. *Acme Industries, Inc., 600 N. Mechanic St., Jackson, Mich.*

▶ *CONTROL VALVE*—catalog sheet "235-1" describes features, operation, and installation information; contains photos and drawings as well as performance curves and list of materials for valve with pressure drop ratio to 300 psi. *Atlas Valve Co., 280 South St., Newark 5, N.J.*

▶ *CONTROL VALVES*—in bulletin "150" includes complete line of valve

FIRST and ONLY FIRE DAMPER

TO RECEIVE THE UNDERWRITERS' LABORATORIES APPROVAL

(Based on a 1½ hour test)

No. VWNYT-1
AUTOMATIC LOUVERED FIRE DAMPER

This acceptance by the UNDERWRITERS' LABORATORIES came only after extensive tests with FIRE DAMPERS constructed according to the present Bulletin No. 90 SERIES, which failed to pass the test, and the IMPERIAL DAMPER No. VWNYT-1, which passed the test, and now carries the UNDERWRITERS' LABORATORIES LABEL.

We, also, at this time, proudly announce the APPROVAL AND LABELING of the IMPERIAL DAMPER No. VWNYT-1 by the BOARD OF STANDARDS AND APPEALS FOR USE IN NEW YORK CITY. This is the FIRST AND ONLY DAMPER to date to carry this approval and label.

Send for Our New Informative Brochure!

IMPERIAL DAMPER COMPANY

Manufacturers of Volume Dampers, Multi-Blade Dampers, Automatic Dampers, Automatic Shutters, Back-Draft Shutters, Louvers, Stationary and Adjustable Extruded Aluminum Louvers.

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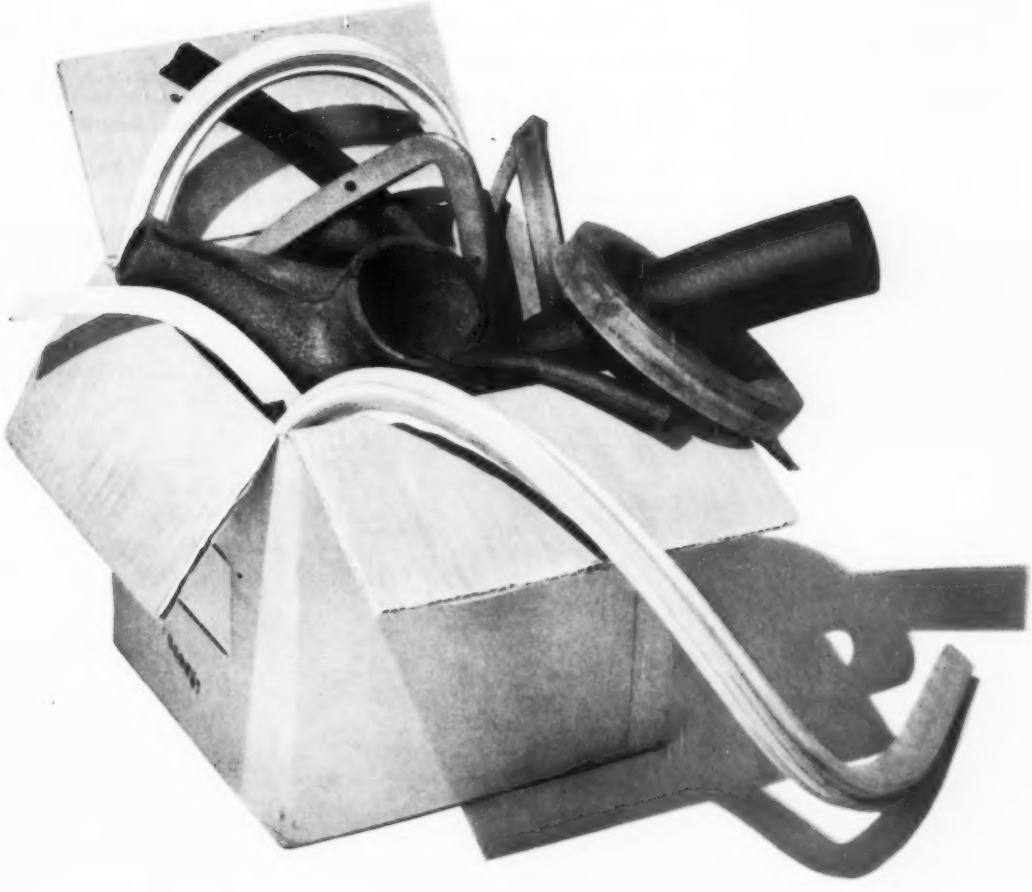
B.F.Goodrich



If it sweats, rattles, shakes or leaks . . .

. . . it shouldn't! And if you ask B.F.Goodrich, it won't! B.F.Goodrich, as the largest producer of sponge rubber and cellular plastic, makes special or standard parts for the refrigeration and air conditioning industry. Typical functions of these parts are sealing, gasketing, insulating and vibration damping – under the most trying conditions.

So get the advantage of the experience that has put B.F.Goodrich cellular materials into The Sheraton Hotel, Philadelphia; The Conrad Hilton, Chicago; The Corning Glass Building, New York and many other New York office buildings. Write The B.F.Goodrich Company, 581 Derby Place, Shelton, Connecticut.

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THE MARK OF QUALITY

BARBER COLMAN

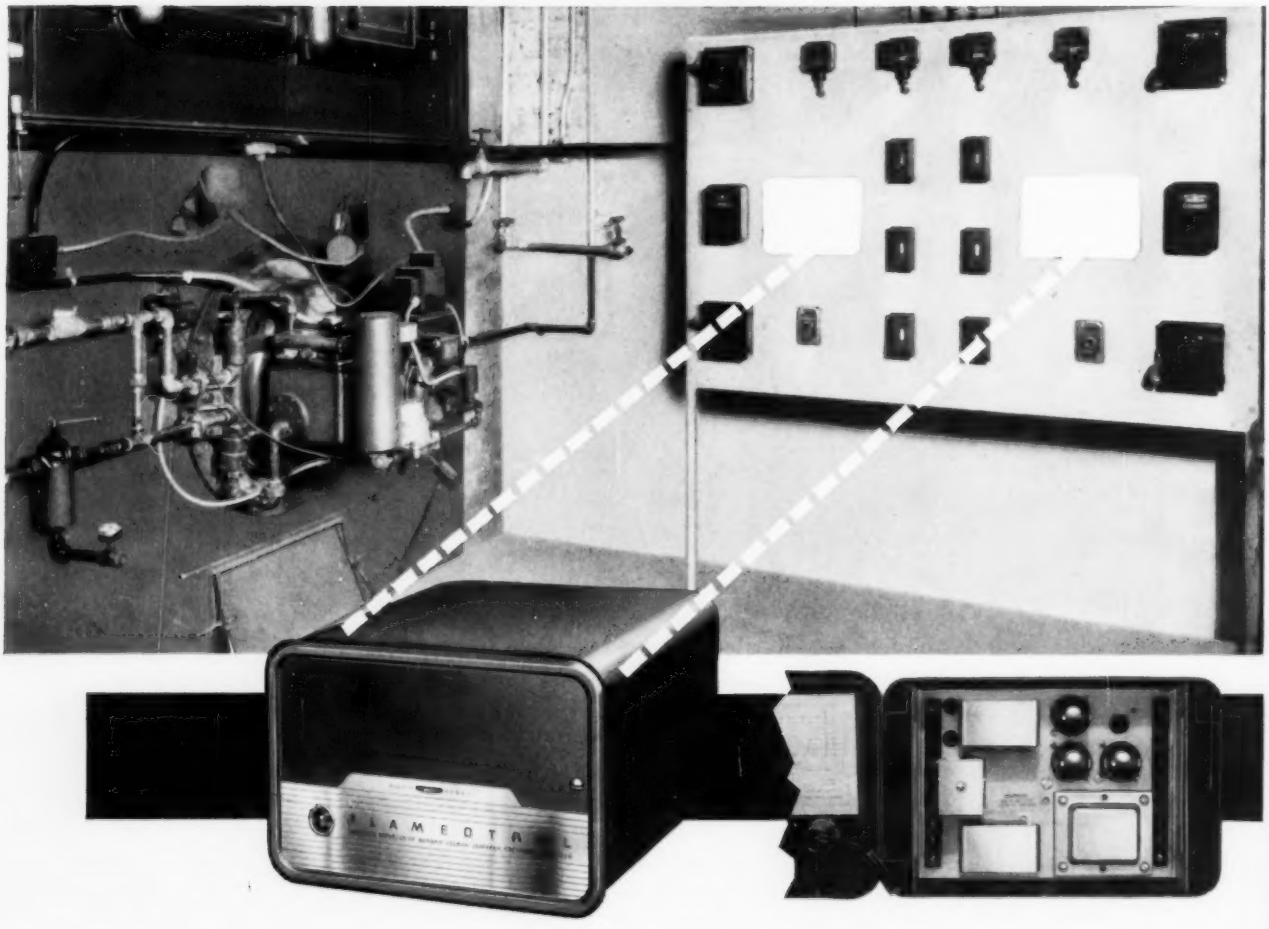
Wheelco Instruments

Look for all these features when choosing combustion safeguards

1. Ability to choose the best system for your needs from a complete line

2. Modern equipment designs to insure long trouble-free life, simple inspection and maintenance

3. Equipment backed up by a nationwide, thoroughly trained field organization



Pushbutton-start Flame-otrols, like the one shown here, are available with a Series 1470 Conductivity-Rectification system or a Series 1570 Infra-Red system.

Convenient external test points for checking circuits and voltages with conventional test instruments. Electronic tubes are standard types simplifying replacement.

write for literature describing Wheelco Flame-otrols

Unless your combustion safeguard system provides all these features you may be making an expensive and needless sacrifice. Wheelco Flame-otrols meet all these requirements whether the application be on a boiler, furnace, kiln, or dryer, and provide them at the cost of conventional equipment.

One Is Best — Wheelco offers two automatic operation and two pushbutton-start Flame-otrols to provide the exact system and the degree of control needed for a particular installation. Either Conductivity-Rectification "CR" systems or Infra-Red "IR" systems are used to monitor the flame. IR systems use a lead sulphide photoconductive cell as the sensing element, while CR systems use flame rods and emissive-type photo cells.

Easy Maintenance — With Wheelco's justly famous plug-in design, inspection and maintenance are easier and faster. The entire chassis may be removed for examination, adjustment, or repair. Standard electronic tubes are used throughout simplifying replacement from local stocks and cutting inventory needs. Wheelco's practical design permits Flame-otrols to be installed in every type of plant location by housing them in rugged, industrial-type steel cabinets provided with a gasketed, dust-tight, swing-out cover.

Control Centers Too — Custom-engineered installations that house a complete combustion safeguard system including Flame-otrols, pilot lights, alarms, etc., have long been a Wheelco specialty. These attractive centralized packages reduce installation costs and time, yet are provided with removable sections that offer flexibility for changing requirements.

Field Engineering Help — It pays to bring the Wheelco field engineer in on your planning when combustion safeguards are needed for a new or modernized installation. His experience plus the availability of a full line of instruments is your assurance of getting the system best suited to your needs. Wheelco field engineers are located in all principal cities, are as close to you as your telephone. This nationwide network, plus specialists in the home office, is always available to help you with your problems.

External and internal views of super-duty automatic Flame-otrols. Programing of these units includes purging, warm-up proving, pilot proving, low-fire stabilization, ignition timing and post-purging.

Custom-engineered Wheelco control centers can incorporate a wide variety of features. Either pushbutton-start or automatic Flame-otrols can be provided.

BARBER-COLMAN COMPANY

Dept. W, 1501 Rock Street, Rockford, Illinois, U.S.A.

BARBER-COLMAN of CANADA, Ltd., Dept. W, Toronto

Industrial Instruments • Automatic Controls • Air Distribution Products • Aircraft Controls • Electrical Components
Small Motors • Overdoors and Operators • Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

Advantages of Constant Volume Regulators in High Velocity Air Transmission

. . . greater design flexibility, stable air delivery, self-balancing operation of branch ducts are typical benefits

The function of a constant volume regulator is twofold:

1. **To reduce high velocity air to conventional velocities;**
2. **To deliver a constant cfm flow as supply duct pressures change.**

Constant volume regulators provide automatic compensation for static pressure variation, and assure balanced system performance under a wide range of operating conditions.

Barber-Colman now makes available a line of standard constant volume regulators and control units to meet nearly every application.

Model SCR Regulator

The completely self-contained, self-operated Barber-Colman constant volume regulator, illustrated in Fig. 1, has proved to be a highly accurate and reliable device. It can be installed anywhere in a single- or double-duct system to maintain constant cfm delivery, regardless of pressure changes upstream or downstream, including those caused by operation of mixing valves or face and bypass dampers.

As illustrated, a flexible diaphragm is actuated by changes in static pressure to control the area of the discharge opening. No separate power source is required. The regulator will operate on as little as 0.5 inches of static pressure in the duct.

Both static and velocity pressure exist under the flexible diaphragm where the air can pass through the discharge plate. Static pressure exists only above the diaphragm where the air is trapped. A static pressure increase above the diaphragm forces it downward against spring pressure, limiting the open area. Conversely, when static pressure decreases, the diaphragm raises, exposing a larger opening area.

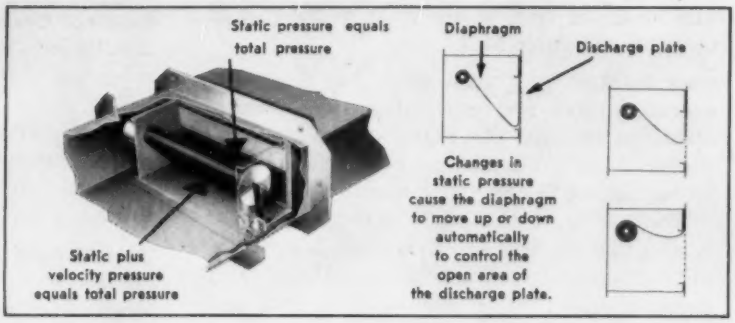

Static pressure equals total pressure
Diaphragm
Discharge plate
Changes in static pressure cause the diaphragm to move up or down automatically to control the open area of the discharge plate.
Static plus velocity pressure equals total pressure

Fig. 1 — Model SCR constant volume regulator can be installed anywhere in a duct system where there are changes in static pressure. It maintains cfm delivery within ±5% for inlet air pressure differences as high as 6 to 1.

The spring tension of the diaphragm roller is set at the factory to meet job requirements, but it can be easily adjusted in the field should requirements change.

Double-Duct Control Units

Three basic types of Barber-Colman double-duct control units combine the basic constant volume regulator with hot and cold air mixing valves. The two valves are controlled by a single motor operator as illustrated in Fig. 2. The housing is acoustically lined to assure very low noise levels.

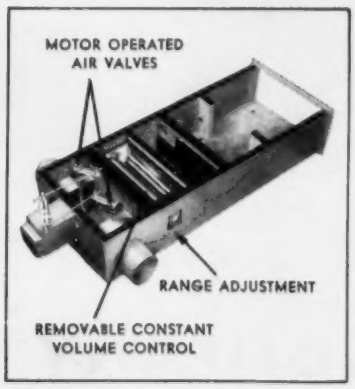


Fig. 2 — Model CV double-duct control unit combines mixing valves with a constant volume regulator.

Standard units meet above-the-ceiling, under-window, or sidewall installation requirements in the vast majority of cases. Modified units are available for unusual situations.

Figs. 3 through 7 illustrate typical applications and the design flexibility of these regulators and control units.

New High Velocity Manual

A new 52-page manual has been developed by Barber-Colman to provide engineers a handy reference source to high velocity design considerations. In addition to a general discussion, it includes data on duct design, air requirements, return air systems, fan selections, temperature control, balancing procedures, and Barber-Colman control units.

Ask for Catalog No. F-6598-1. Call your local Barber-Colman air distribution field office or write.

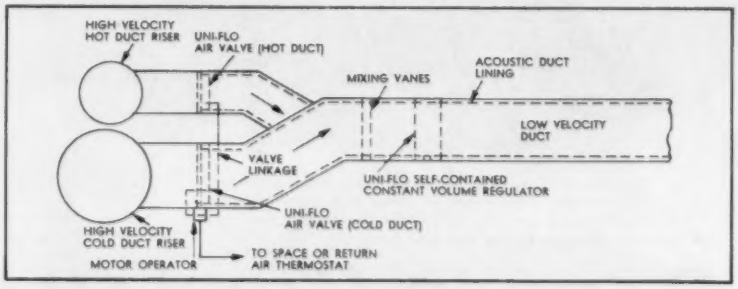


Fig. 3 — Double-duct system with motor-operated air valves for hot and cold air mixing and a model SCR regulator to provide constant cfm delivery to the low velocity duct. A Model CV unit (Fig. 2) could be used instead of the two valves and the single SCR regulator.

Instead of a single SCR regulator, individual ones can be installed in branch ducts. In this case, the low velocity duct system would be self-balancing.

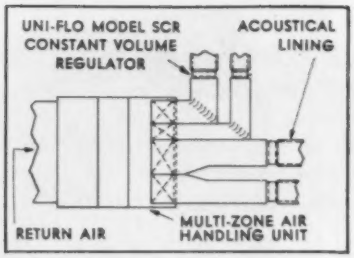


Fig. 4 — Multizone system with SCR regulators in each zone to provide constant cfm delivery.

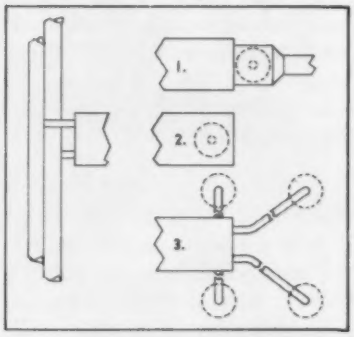


Fig. 5 — Double-duct system illustrating several applications of Model CV control units. Circles indicate ceiling diffusers. (1. CVE open-end unit; 2. CVD with integral diffuser; 3. CVO with octopus outlets.)

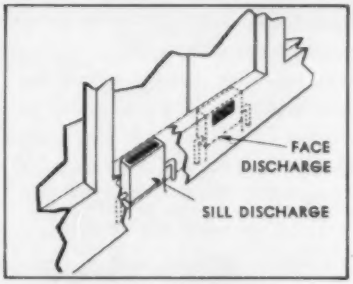


Fig. 6 — Double-duct control unit for under-window mounting. Model SWC furred-in units shown.

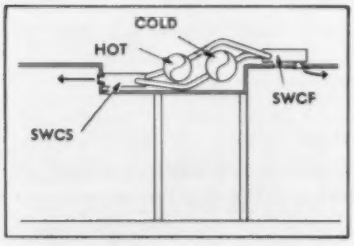


Fig. 7 — Model SWC double-duct control units installed above ceiling for use with ceiling and sidewall diffusers.

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Dept. W, 1101 Rock Street, Rockford, Illinois

RECENT TRADE LITERATURE

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bodies and actuators and accessories; bulletin contains sizing data, complete description of valve advantages, and full diagrams included. *DeZurik Corp., Dept., CV, Sartell, Minn.*

▸ *COPPER FITTING*—catalog "SF-59" contains information on making solder joints and flared connections; includes data on types of solders and working pressures, dimensions of tubing, and friction loss allowances. *Chase Brass & Copper Co., 40 E. Farm St., Waterbury 20, Conn.*

▸ *DIRECT FIRED HEATERS*—in three new models described in specification sheets; each sheet contains dimension drawings of floor mounted and horizontally suspended units. *Wanson Corp., Charles & Juniata Sts., Lewistown, Pa.*

▸ *DUST COLLECTORS*—with special applications in petroleum refining operations in bulletin "300"; contains detailed drawings and application diagrams. *Research-Cottrell, Inc., Bound Brook, N.J.*

▸ *ELBOW FANS*—for ventilation and for ovens, furnaces, dryers and kilns described in bulletin "VEF-59"; included are tables of sizes and dimensions, selection data including capacities from 600 to 32,000 cfm. *L. J. Wing Mfg. Co., 140 Vreeland Mills Rd., Linden, N.J.*

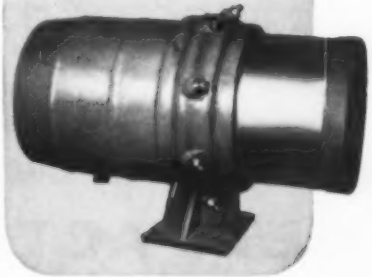
▸ *ELECTRIC HEATERS*—including baseboard, wall panel, and ceiling-recessed types in catalog "GC-106"; contains complete specifications as well as technical information on uses and operation. *Berko Electric Mfg. Corp., 212-40 Jamaica Ave., Queens Village 28, N.Y.*

▸ *FEED WATER CONTROL SYSTEMS*—for boiler system applica-

important points about joints

- Yarway Gun-Pakt Joints are serviced *in the line under full steam pressure.*
- Costly shutdowns eliminated.
- Maintenance records show 1 manhour per year per joint.
- Fewer expansion joints needed per length of pipeline with Gun-Pakt.

YARWAY GUN-PAKT EXPANSION JOINTS



For new Yarway Expansion Joint Catalog EJ-1916 write YARNALL-WARING CO., 107 Mermaid Lane, Phila. 18, Pa.

go YARWAY with confidence

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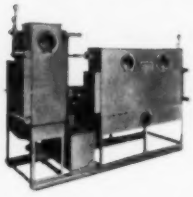
Give these advantages to specifying engineers:



STERILE AIR

Now you can design spaces to maintain air sterility as scientifically as temperature and humidity. Only Kathabar enables you to deliver air at 5 micro-organisms per 10 cu. ft. or less, continuously.

FROST-FREE COOLING

Get continuous air supply at dry bulbs and dew points way down to −90 F. No freeze-ups... no fluctuating efficiency... no defrosting shutdowns... no duplicate sets of coils. Cool better; fewer tons. Proved in candy cooling... photo film chilling... brewing... chemical processing... environmental testing... many other applications.

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SURFACE COMBUSTION CORPORATION
2384 Dorr Street, Toledo 1, Ohio

Send facts on Kathabar systems for following application:

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company.....
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city .....*zone*.....*state*.....

Surface

59-2E

RECENT TRADE LITERATURE
Continued

tions described in detail in bulletin "531"; contains chart for application of proper system; principle of operation of each system variation fully detailed. *Bailey Meter Co.*, 1050 *Ivanhoe Rd., Cleveland* 10, *O.*

▸ *FINNED TUBE*—brochure containing alloy code of constituent metals correlated with dimensional chart from 5/8 to 1 in. outside diam. *Wolverine Tube Div. of Calumet & Hecla, Inc.*, 17206 *Southfield Road, Allen Park, Mich.*

▸ *FLEXIBLE COUPLINGS*—ranging from fractional to 190 hp per 100 rpm described in bulletin "A669C" with detailed tables of horsepower ratings, dimensions, and service factors for applications. *Dodge Mfg. Corp., Mishawaka, Ind.*

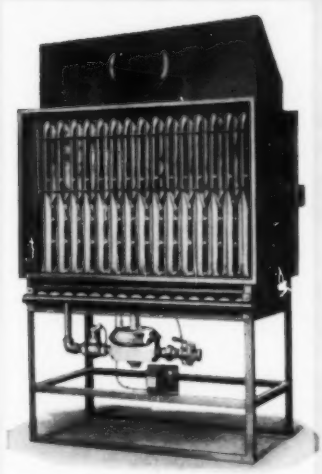
▸ *GASKET, SHIM GUIDE*—in choosing gasket for specific applications; brochure divided into 5 sections: gaskets, shims, washers, installation accessories, new filler material. *Akron Metallic Gasket Co.*, 150 *N. Union St., Akron* 9, *O.*

▸ *GATE VALVES*—in two complete lines described in new brochure; available in rising stem and non-rising stem in sizes 1/4 to 3 in. screwed ends. *Crane Co.*, 836 *S. Michigan Ave., Chicago* 5.

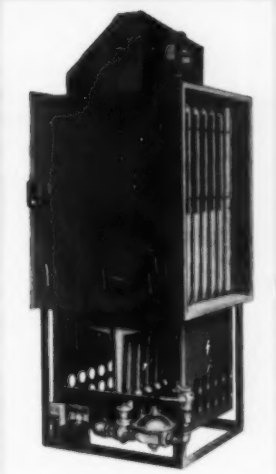
▸ *HEAT EXCHANGER TUBES*—for process industries described in bulletin "TB-431"; special emphasis on manufacturing procedures illustrated and quality control methods outlined. *Babcock & Wilcox Co., Tubular Products Div.*, 712 *Eleventh St., Beaver Falls, Pa.*

▸ *HEATING HANDBOOK*—including sections on steam and hot water heating systems, radiation, unit heaters, pumps, specialties, control

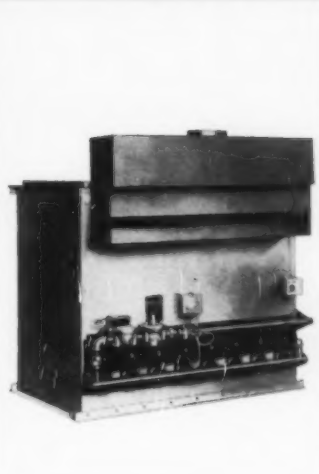
HAYES STAINLESS STEEL HEAT EXCHANGERS



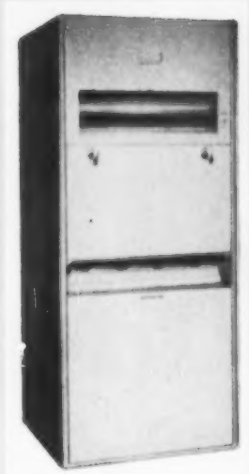
SED-E



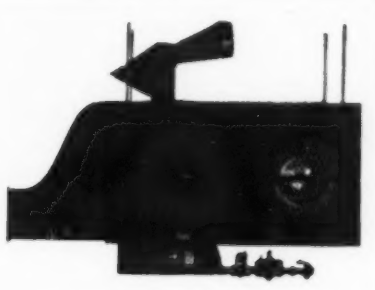
SED-S



SED-VF



SEC



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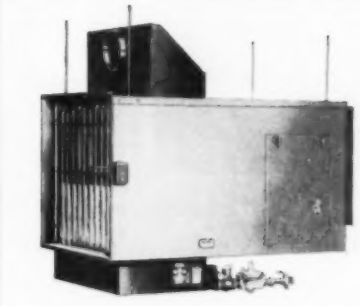
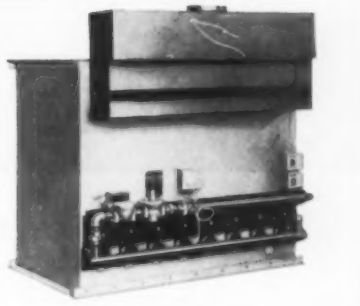


SES



SED-CF

SED-E — Non-corrosive type 321 stainless steel heat exchanger. Permits installation down-stream of cooling equipment, for continuous blower operation. Air through-put in either direction. 45,000 to 675,000 Btu input.

SED-S — Same as SED-E except controls are at the side. Either SED-E or SED-S is available in sizes from 45,000 to 675,000 Btu input in increments of 45,000 Btu.

SED-VF — Tested and approved as a duct furnace; type 321 stainless steel. Re-circulated or fresh air enters through bottom, sides, or back. Built-in air bypass, vent in front. 7 sizes from 70,000 to 280,000 Btu input.

SEC — Forced air furnace. Stainless steel heat exchanger sections seam and arc welded. One piece cast iron burners with drilled ports. Oversize double inlet blower. 7 sizes — 70,000 to 245,000 Btu input. For zero clearance.

SEU — Suspended unit heater. Recirculates room air. Diffuser outlet with adjustable vertical and horizontal vanes. Double inlet forward curve blower. Continuous duty, variable pitch drives, raised port burners. 80,000 to 480,000 Btu input.

SES — Forced air, suspended furnace for installation in suspended duct system. Designed for sheet metal duct connection. Double inlet forward curved blower. Continuous duty variable pitch drives, raised port burners.

SED-CF — Tested and approved as a duct furnace for counterflow. Recirculating fresh air thru the top. Has a built-in bypass. Sizes from 70,000 to 280,000 Btu input.

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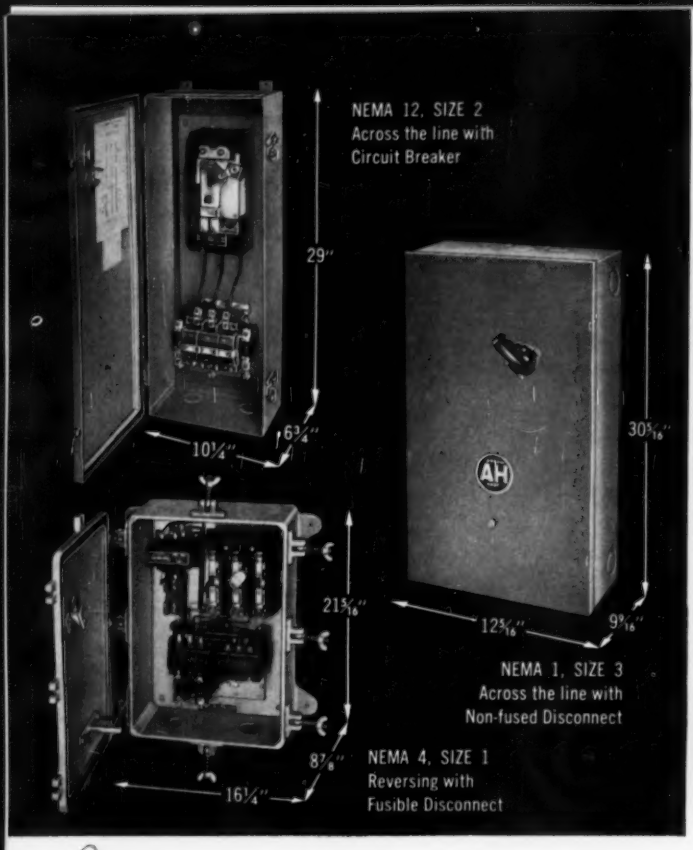

Announcing: **A COMPLETE LINE OF COMPACT, LIGHTWEIGHT COMBINATION STARTERS**

Sizes 0, 1, 2, and New Sizes 3 and 4—and NEW CAST ALUMINUM WEATHERPROOF and EXPLOSIONPROOF ENCLOSURES

Starters are of exclusive "Right Angle" Design which brings important installation, maintenance and performance benefits. For convenience and safety, unit is front operated by means of Fused or Unfused Disconnect, or Circuit Breaker. Circuit Breakers are Instantaneous or Thermal Magnetic Trip Types. *No other line offers enclosures that facilitate mounting and handling like the new cast aluminum NEMA 4 Weatherproof and NEMA 7 and 9 Explosionproof – Enclosures that are one-half the weight of old-style cast iron boxes.* Other available enclosures: General Purpose (NEMA 1) and Industrial (NEMA 12 – oil-tight and dust resistant).

Write for new folder on A-H Combination Starters to: The Arrow-Hart & Hegeman Electric Company, Dept. HPAC, 103 Hawthorn St., Hartford 6, Conn.

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Quality since 1890

MOTOR CONTROLS • ENCLOSED SWITCHES
APPLIANCE SWITCHES • WIRING DEVICES

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RECENT TRADE LITERATURE

Continued

equipment, radiation, unit heaters, special purpose pumps and related products, engineering data, terminology; available at $1.00 per copy. *Dunham-Bush, Inc., 179 South St., West Hartford 10, Conn.*

▸ *HEAVY DUTY MOTORS*— with ratings of ½, ¾, and 1 hp detailed in fact sheet which includes specifications, special features; motors have application for sump pumps and are induction run types. *Franklin Electric Co., Inc., 345 E. Spring St., Bluffton, Ind.*

▸ *HINGED CLOSURES*—with built-in safety features in new brochure; designed for service in petroleum, gas transmission, chemicals and other industrial piping applications; includes charts of dimensional specifications and cross-sectional drawings of design features of various sizes and types. *Tube Turns Div. of Chemetron Corp., 224 E. Broadway, Louisville 1, Ky.*

▸ *HOOD VENTILATORS*—for commercial kitchens are described in catalog "1201" along with specifications and dimensions for basic models; contains installation procedures, design data, and how to select size. *Morrison Products, Inc., 16816 Waterloo Rd., Cleveland 10, O.*

▸ *HOSE ASSEMBLIES*—for hydraulic, and air fluid systems described in catalog "C-300"; contains 128 pages of specifications, technical data, sizes, descriptions, applications, installation instructions. *Weatherhead Co., Fort Wayne Div., 128 W. Washington Blvd., Fort Wayne, Ind.*

▸ *IMMERSION HEATING BOILER*—for commercial and industrial space heating; bulletin "5209-B" illustrates and describes low pressure models in range of sizes from 80 to

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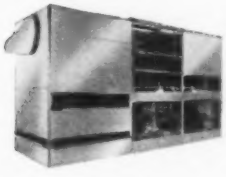
Self-Contained Unit
With Evap. Condenser Type SCU

From 11 Basic Models
30 Possible Combinations

Self-Contained Unit
Multi-Zone Type SCMZ

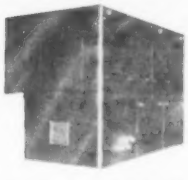


From 11 Basic Models
50 Possible Combinations

Self-Contained Unit
Shell and Tube Type ST

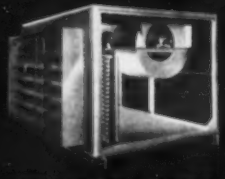
From 13 Basic Models
25 Possible Combinations

Self-Contained Unit
Multi-Zone Type STMZ



From 13 Basic Models
25 Possible Combinations

Horizontal Air Conditioner
Type GHC



From 14 Basic Models
56 Possible Combinations

Vertical Air Conditioner
Type GVC

From 14 Basic Models
56 Possible Combinations

Multi-Zone Air Conditioner
Type GMZ

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84 Possible Combinations

Evaporative Condensers
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28 Possible Combinations

*ChillPak Water Chiller
Type CPS

From 10 Basic Models
68 Possible Combinations

*Cabinet models available with built-in or remote evaporative condenser.

ORIGINATORS AND DEVELOPERS OF COMPLETELY PACKAGED AIR CONDITIONERS

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GOVERNAIR

WRITE FOR FURTHER INFORMATION ON ANY SPECIFIC UNIT, OR SEE OUR LISTING IN ASHACE "GUIDE."

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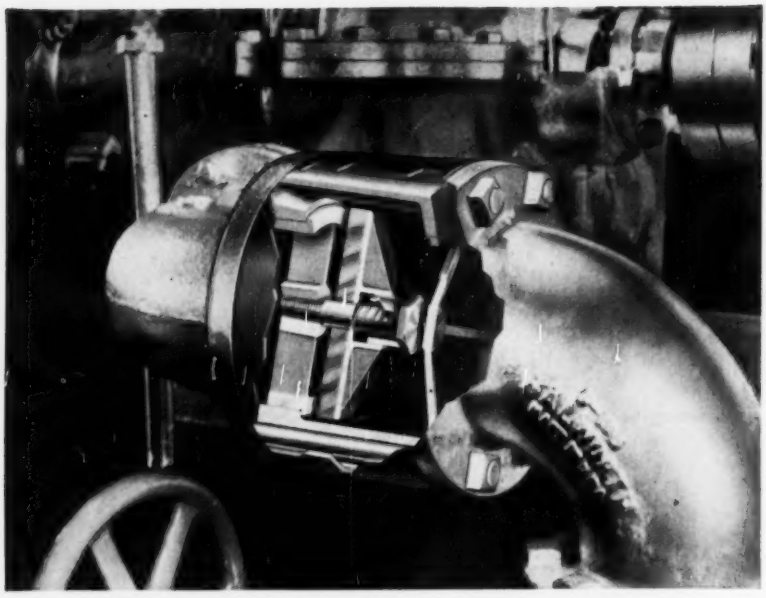

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SOLD BY RELIABLE AGENTS IN PRINCIPAL CITIES

RECENT TRADE LITERATURE

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500 hp and 10 to 65 hp. *Sellers Engineering Co., 4876 N. Clark St., Chicago* 40.

▸ *INDUSTRIAL FANS*—incorporating universal discharge to facilitate field modifications to duct work if required presented in bulletin "L-5"; includes complete rating tables, tables on correction ratios for deviations from standard atmospheric conditions at sea level, specifications, dimensional data for complete line. *Lehigh Fan & Blower Div., Fuller Co., Catasauqua, Pa.*

▸ *INDUSTRIAL INSULATIONS*—for sub-zero to 1900 F temperature range applications; form "6451" includes tabular product selection guide and specific applications from high temperature and superheated surfaces to cold water piping and air conditioning ducts. *The Philip Carey Mfg. Co., 320 S. Wayne Ave., Lockland, Cincinnati* 15, *O.*

▸ *LUBRICATING DEVICES*—including automatic oilers, mist systems contained in catalog No. "59"; includes data on types and uses as well as capacities and sizes. *Trico Fuse Mfg. Co., 2948 N. 5th St., Milwaukee* 12, *Wis.*

▸ *MASTER CONTROLLER*—for use with automatic combustion control systems in catalog "CMC-687" which includes specifications, description of components, application data, installation instructions, dimensions, wiring diagrams. *Cleveland Controls, Inc., 1111 Brookpark Rd., Cleveland* 9, *O.*

▸ *MOTORS, BLOWERS*—for air conditioners and small ventilators fully described and illustrated in new

VIBRATION & NOISE CONTROL NEWS

FROM THE APPLICATION ENGINEERING DEPARTMENT OF THE KORFUND COMPANY, INC.

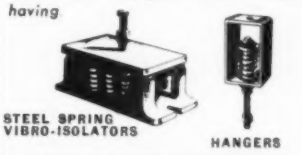
"Complete Package" Vibration and Noise Control

For years, air conditioning engineers and contractors have recognized Korfund Vibro-Isolators as the one sure means of stopping noise and vibration transmission through floors and structure.

Add Korfund Vibro-Hangers for suspending piping or equipment, and Flex-Hose for flexible piping connections and you have the whole vibration and noise control package.

Backed by a great name, with more than a half-century of experience in licking tough vibration problems, Korfund's three-way control package comprises a complete range of types and designs to meet any requirement.

Basic types of Korfund's vibration and noise control units are pictured below. For complete specifications write for Bulletin 68; you'll find it worth having.



STEEL SPRING VIBRO-ISOLATORS

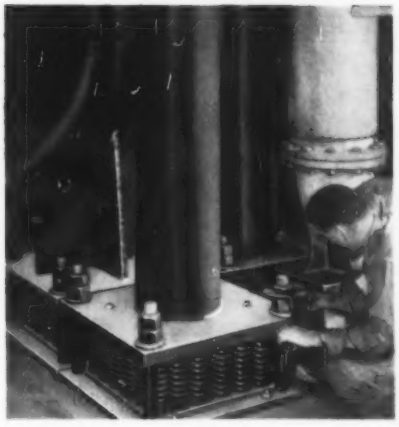
HANGERS

FLEX-HOSE—Metal or rubber.

30 STORY AIR CONDITIONING SYSTEM FLOATS ON SPRINGS FOR TOPS IN TENANT COMFORT

Tenant comfort was the chief aim when the Philadelphia Fidelity Trust Building, Philadelphia, Pa. decided to install complete summer-winter air conditioning. Providing correct temperature control throughout the 30 story building was one big consideration; another was to make certain that noise and vibration from mechanical equipment and piping would not disturb users of the office areas.

Working with consulting engineer Charles S. Leopold, Korfund engineers mounted pumps, compressors and other main conditioning equipment on steel spring isolators. Risers to the cooling towers offered a special problem. Transmission of vibration from the big pipes had to be prevented, and proper allowance had to be made for expansion and contraction without setting up stresses in the system. Specially designed Korfund spring mounts, supporting each of the risers at the bottom only, provided the answer. Together with the standard spring mounts used under the mechanical equipment, noise and vibration transmission was eliminated, insuring tenant comfort.



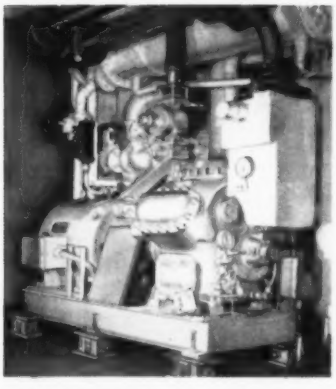
Four risers extending 29 stories to cooling tower, are supported by spring mounts. Filled weight 500,000 lbs.

Vibro-Hangers Put Gag on Talking Pipes at Chrysler

Photo shows some of the steel spring Vibro-Hangers used to prevent "talking" pipes in Chrysler Corporation's Kokomo, Indiana, plant. Resilient hangers prevent transmission of noise and vibration through ceilings into building structure, insure quiet in the office area overhead.

Units are part of the "complete package" of vibration and noise control engineered by Korfund. Included in the installation are vibration and noise isolation bases for fans and motors.

Vibration Control Increases Ship's Useable Living Quarters



Korfund isolators are used to mount five compressors and pumps on the S.S. Brasil and S.S. Argentina. Korfund Flex-Hose stops noise and vibration transmission thru piping.

Sister ships, S.S. Brasil and S.S. Argentina, have been called the "Last word in luxury afloat." However, their refrigeration system transmitted vibration and noise through the steel decking, making it virtually impossible to occupy living quarters near the installation.

Korfund engineers quickly saw that piping as well as compressors and pumps were the cause of the trouble, and recommended *two-way* vibration and noise control. Steel spring mounts were used beneath the equipment, metal Flex-Hose stopped transmission through the piping.

Whether for "luxury afloat" — or for critical commercial or industrial installations, Korfund's "complete package" provides the effective, economical solution to vibration and noise problems.

FOR MORE DATA OR SPECIFIC RECOMMENDATIONS WRITE TO KORFUND FOR BULLETIN #68

THE KORFUND COMPANY INC.

48-01F Thirty Second Place • Long Island City 1, New York

Over half a century of VIBRATION • SHOCK • NOISE / CONTROL & MEASUREMENT

Vibration & Shock Isolators • Flexible Connectors • Vibration Instruments • Acoustical Products

CHECK *the Advantages of* GOODALL *Rubber* EXPANSION JOINTS

Goodall Expansion Joints have not only the advantages stemming from the natural characteristics of rubber for all types of installations, but, what's more important, they have back of them Goodall's engineering skill, manufacturing experience and reputation for quality that give *added* assurance of exceptional service under all conditions.

EASIER TO INSTALL...

Goodall Rubber Expansion Joints are quickly, easily installed on new construction or as replacements. They are light in weight to facilitate handling, with short face-to-face dimensions for easier application where space is limited. Retaining rings are quickly aligned and bolted. No gaskets are required.

RESPONSIVE TO MINIMUM PRESSURE...

With Goodall Rubber Expansion Joints only the slightest pressure is required to create movement in any direction. Result—stress on metal pipe or other member is eliminated or, at most, reduced to an absolute minimum.

MANY SIZES...HIGH WORKING PRESSURES...

Goodall Rubber Expansion Joints are available in sizes from ⅜" to 96" I.D., in all required styles and constructions. Working pressures range up to 125 P.S.I. for Pressure Joints, and to 90 P.S.I. for Vacuum-Pressure Joints, depending on size.

LONGER SERVICE LIFE...

Goodall Rubber Expansion Joints last longer in service because of inherent characteristics of the material from which they are made. There is no embrittlement... continuous movement (flexing) actually keeps the rubber joint "alive". There is no corrosion or electrolysis. Resistance to abrasion is exceptionally high. Replacement costs are lower.

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GOODALL *Rubber Company*

GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

BRANCHES AND DISTRIBUTORS THROUGHOUT THE UNITED STATES. IN CANADA: GOODALL RUBBER CO. OF CANADA LTD., TORONTO.

RECENT TRADE LITERATURE

Continued

12 page catalog; contains horsepower rating charts including dimensions and diagrams. *Redmond Distributors Div., 201 Monroe St., Owosso, Mich.*

▸ *OIL BURNER*—in capacity range from 0.75 to 20 gph; bulletin No. "113B" contains tables of descriptions of each model, dimensions, diagrams of standard models, Btu inputs, safety time for ignition and flame failure. *National Airoil Burner Co., Inc., 1284 E. Sedgley Ave., Philadelphia 34, Pa.*

▸ *PACKAGE BOILER*—with all wet back construction is described and illustrated in bulletin "B-3240" along with mechanical and thermal features; includes certified results of operational tests for units up to 900 hp. *Titusville Iron Works Div., of Struthers Wells Corp., Titusville, Pa.*

▸ *PACKAGED BOILER*—designed for low pressure steam or hot water heating in 15 to 25 hp range; new bulletin describes features of boilers which include integral oil, gas, or combination firing equipment and wide selection of control and safety features. *Orr & Sembower, Inc., Box 1138, Reading, Pa.*

▸ *PACKAGED BOILERS*—for gas, oil and combination gas-oil use; new bulletin contains ratings, dimensions, cutaway drawings of all sizes of boilers. *Orr & Sembower, Inc., Box 1138, Reading, Pa.*

▸ *PIPE INSULATION*—for air conditioning equipment in new bulletin "C-9-271"; gives insulating uses for plastic material as well as charts and graphs of thermal conductivity and density. *Plastics Div., Koppers Co., Inc., 801 Koppers Bldg., Pittsburgh 19, Pa.*

Curtis

CONDITIONS COMMERCIAL AMERICA...

See our exhibit—
Booth 209
Air Conditioning &
Refrigeration Exposition
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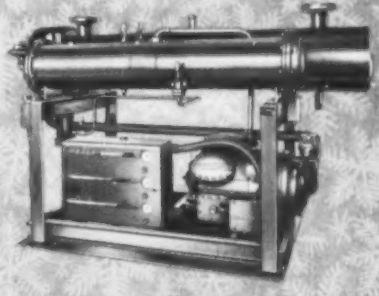
Nov. 2 thru Nov. 5, 1959

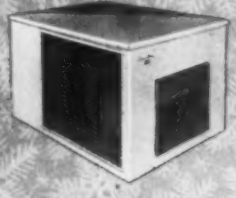
Curtis packaged units minimize floor area required. Factory assembled and tested. Field installation requires only setting and connecting utilities.

PACKAGED AIR CONDITIONERS UP TO 100 TONS.



PACKAGED LIQUID CHILLERS UP TO 100 TONS.

AIR-COOLED UNITS UP TO 10 TONS.



PRECISION

close tolerance manufacturing, builds peak performance into every CURTIS unit.

Curtis is the "luxury line" in the air-conditioning industry. Silence, efficiency and long-life are inherent in Curtis design.

Yet Curtis prices are right in line.

This is why Curtis designs and builds thousands of unique air conditioning systems for commercial America . . . why Curtis is able to maintain a family of over 300 representatives and servicing contractors across the nation.

Put the advantages of CURTIS PRECISION into your next job.

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MANUFACTURING COMPANY
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OUR 105th YEAR

WRITE DEPT. 5, ST. LOUIS 20, MISSOURI

THE CURTIS "LUXURY LINE" OF AIR CONDITIONERS COSTS NO MORE

THE MARK OF QUALITY

BARBER COLMAN

New proportional regulator provides highly accurate control of temperature

For water, gas, or steam

Temperature ranges from −40° to +350° F

Calibrated temperature dial

Positive positioning

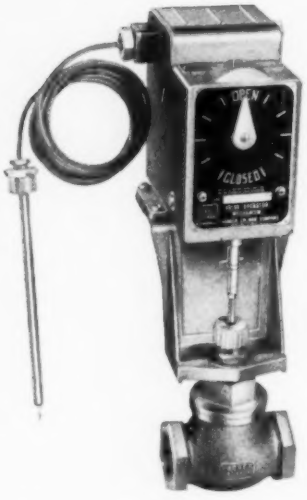
Fully proportional

Tight closing

High reliability

Self-contained

Easy-to-read valve position indicator



New Barber-Colman motor-operated proportional temperature regulators offer distinct advantages on any process or space heating or cooling applications requiring positive, accurate control.

Throttling range is adjustable from 2 to 25°. Auxiliary switches provide means of interlock to pumps, boilers, refrigeration compressors, etc. Optional features include speed adjustment, fail-safe spring return, and neutral band operator for heating/cooling.

Construction is exceptionally rugged and dependable. A positive-acting electric motor operator delivers full power throughout the complete valve operating stroke, assuring positive shutoff and accurate throttling. Motor operators are offered for use with most commonly used power sources. Motor and gear train are submerged in oil for long life and with minimum maintenance. A built-in feedback mechanism minimizes over- and undershooting.

Valve body types include single seat, double seat, three-way, single seat pilot balanced, and are available in bronze, iron, steel, and stainless steel. Available in screwed and flanged patterns for most sizes.

Regulators are sold complete, ready to install. For detailed specifications, call your local Barber-Colman Automatic Controls office, or write for descriptive literature.

"Better Control . . . Electrically"

BARBER-COLMAN COMPANY

Dept. W, 1301 Rock Street, Rockford, Illinois

RECENT TRADE LITERATURE

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▸ *PIPE INSULATION*—that withstands hard knocks, lends itself to various applications described in new brochure "IN-155A"; included is specification data on characteristics. *Johns Manville, 22 E. 40th St., New York 16.*

▸ *PIPE TAPE*—featuring resistance to corrosion; new bulletin contains complete pipe coverage chart; tape applications include piping for oil, gas, chemicals, and other industrial processes. *Chase & Sons, Inc., 26 Spruce St., North Quincy, Mass.*

▸ *PIPELINE STRAINERS*—with 250 psi bodies and tensile strength of 30,000 psi minimum; bulletin No. "1210-1" provides dimensions and weights for two types available as well as design features. *Sarco Co., Inc., 635 Madison Ave., New York 22, N.Y.*

▸ *PLASTIC PIPE*—for processing industries, utilities, marine, and general industrial use discussed in bulletin "CE-80" which includes chart data on properties, dimensions, and applications. *American Hard Rubber Co., Div. of Amerace Corp., Ace Road, Butler, N.J.*

▸ *PLASTIC PIPE FITTINGS*—including tees, elbows, unions, trap units detailed in bulletin "2"; contains dimensions, applications, specifications, all in tabular form for each size and style of fitting. *American Vulcathene Div., The Nalge Co., Inc., P.O. Box 365, Rochester 2, N.Y.*

▸ *PORTABLE HEATER*—designed for use in construction; heater described in new literature has up to 75,000 Btu per hr output and weighs 4 lb. *Wood Enterprises, Inc., 1143 Belvoir Ave., Dayton 9, O.*

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Superior ruggedness and corrosion resistance of Super Air-Vans has been demonstrated in 8½ years of research, testing and actual use. That's why, today, Gallaher gives you comprehensive, long term protection for you and your client. We will repair or replace any unit which does not meet the 10-year test.

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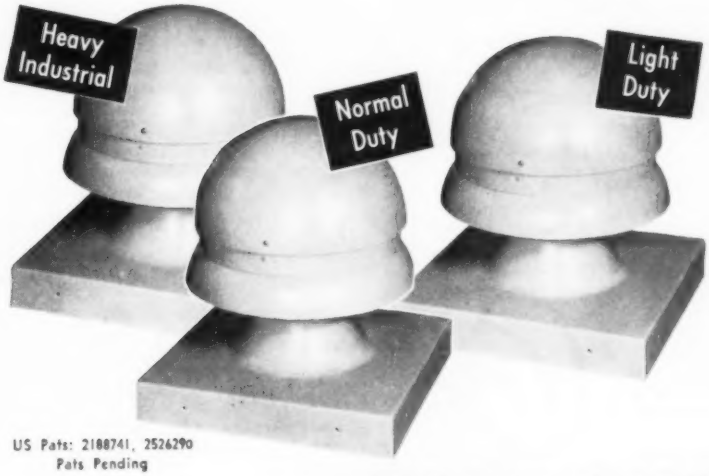
NOW SUPER/AIR-VANS® in FIBERGLAS* available in 3 budget-rated models



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Here's dollar efficiency — Three distinct models are available, each one carefully scaled to the job and priced accordingly. You can pinpoint your exact need. Whether it's hot-dog fumes or nitric acid, there is a SUPER/AIR-VAN, budget-rated for the job.

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Static Pressures to 4"

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...with the New REED ROTARY CUTTERS

(4 sizes cover the range from 10" cast iron to 26" steel pipe)

These one-man Reed Rotary Cutters cut large diameter steel or cast iron pipe *faster and better than the heaviest power machines* . . . and without electrical or explosive hazards. What's more, there's less digging in ditch-work! You need only a 4" to 6" channel under the pipe and a 45° to 60° arc for the handle swing. Reed Rotaries are easy to "carry in", too. The 20" size weighs only 68 pounds; separates into 3 easily carried parts. Patented pipe guide assures clean, right-angle cuts. Four razor blade wheels track perfectly, cut easily and are quickly interchangeable for steel or cast iron pipe.

- Write today for descriptive literature.

These typical cuts on 12, 16, 20 and 24" cast iron pipe illustrate the clean, accurate, right-angle cuts provided by Reed Rotary Cutters.

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RECENT TRADE LITERATURE

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▸ *PRESSURE REGULATORS*—featuring sliding gate seats are described in bulletin "J-DI"; includes composition, properties, specifications, comparison tables; test results. *OPW-Jordan, 6013 Wiehe Rd., Cincinnati* 13, *O.*

▸ *PROCESS INSTRUMENTATION*—systems and controls featured in bulletin "B-I-F 5-1" for controlled feeding of solids and liquids; bulletin includes information of each model such as accuracy, range, capacity, and uses. *B-I-F Industries, Inc.,* 345 *Harris Ave., Providence* 1, *R.I.*

▸ *PROPORTIONING PUMP*—for treating process water for industry discussed in bulletin No. "1210.20-1" available in model for proportioning up to 11, 22, 33 gph into discharge pressures up to 125 psi. includes installation diagrams, capacity chart. *B-I-F Industries, Inc.,* 345 *Harris Ave., Providence* 1, *R.I.*

▸ *PROPORTIONING PUMP*—for injection of boiler water treatment chemicals into low pressure boilers; bulletin "1107.20-1" contains engineering data including capacity, injection pressure, construction materials. *B-I-F Industries, Inc.,* 345 *Harris Ave., Providence* 1, *R.I.*

▸ *PUMP SHAFT SEALS*—for water systems discussed in technical bulletin "591"; literature describes common causes for failure, results of tests, steps to be taken in order to reduce difficulties with mechanical seals. *Water Service Laboratories, Inc.,* 615 *W.* 131*st St., New York* 27, *N.Y.*

▸ *PYROMETERS, INDICATORS*—in numerous sensitivities, styles and

Expansion Joint Design Moves out of the "Model T" Era

Badger first began fabricating packless metal bellows expansion joints more than 35 years ago. These "Model T" joints performed (and are still performing) with outstanding success in hundreds of process and steam line piping installations.

Starting in the 30's other expansion joint manufacturers entered the field. The most successful adopted many of the basic features of the original Badger design.

During the last decade, as industry's requirements became more stringent, and joint manufacturers gained fabricating and field experience, certain fundamental problems inherent in the early designs became evident. Most of these problems were solved through a series of modifications. (Among which was the Badger Directed Flexing Self-Equalizing Joint — the famous "DFSE" Design.) But, at best, the modifications were stop-gap measures which complicated the joints and greatly increased their weight. A fundamental reassessment of expansion joint engineering data was needed. Badger led the way: In 1956, a task force completed a three-year research program and the first S-R (Service-Rated) Expansion Joints were produced.

In the three years they have been available, S-R Expansion Joints have been both an engineering and a sales success. But like many revolutionary concepts which upset tradition, the full implication of the advantages S-R Joints offer is still not universally understood. The message that follows is an attempt "to set the record straight."

• • • • •

Equalization — fact and fiction

Many users of expansion joints are under the impression that the so-called "equalizing" rings on today's conventional type expansion joints distribute movement equally among all the corrugations of the bellows. It is argued that as the joint absorbs thermal movement, the tops of the rings progressively come into contact until the bellows is fully compressed thus limiting the amount of compression which any one corrugation can ultimately absorb (see diagram 1). In *this* sense the rings do contribute to the "equalization" of movement by physically limiting the compression of each corrugation to the distance between any two adjacent rings.

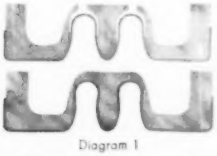

Diagram 1

Conventional Type Expansion Joint. Cross-sections of rings and bellows of a conventional "self-equalizing" joint showing cold and hot positions. Note that true equalization of movement can only be obtained when tops of all rings are in contact — an impractical and dangerous situation.

Note, however, that the degree of compression will not be truly equalized until the tops of all the rings are in contact. But, when such a condition occurs, serious problems will result. If the limit of compressibility is reached before the thermal expansion has been completely absorbed, exceedingly large forces will be transmitted through the pipe line to the anchors and connected equipment. On the other hand, if the joint is compressed only partially, not all of the corrugations will absorb movement to the same degree.

How S-R Joints solve equalization problem

Badger S-R Expansion Joints feature the new Ourvilinear Corrugations which naturally assume an "all curve" shape under pressure (diagram 2), assuring more equal distribution of stresses throughout the bellows material. Furthermore, the shape, height and pitch of the corrugations are based on a carefully engineered correlation. Thus, reasonably equal distribution of movement among the corrugations is obtained, even in joints not equipped with reinforcing rings.

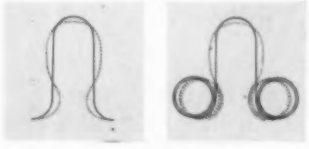

Diagram 2

Badger S-R Expansion Joint. Cross-sections of S-R Joints (Series 50 left, Series 150 right). The movement of the corrugations is shown by dotted and solid lines. Compare configuration and effective height of corrugations, position and size of rings with conventional joint.

Equalization of movement is inherent in the design and functioning of the bellows on Badger S-R Joints. On the basis of provable engineering criteria, the prime purpose of reinforcing rings of any design is to retain the hoop dimension (diameter) of the corrugations when they are subject to internal pressure. This Badger's simple, lightweight tubular reinforcing rings do. But, in addition, the new tubular shape of the rings does contribute to joint flexibility and life by permitting flexing over a more effective portion of the total corrugation height than conventional cast or fabricated equalizing rings.

Better performance, lower cost

Briefly, then, Badger S-R Joints alone offer these advantages: Better equalization of movement which results in elimination of localized stresses and leads to longer joint life; a simple, lightweight design that makes installation easier, eliminates cumbersome castings and fragile mechanical devices; complete range of sizes from 3" to 72" made from any workable metal and with a wide choice of accessories.

Badger S-R Joints are probably the answer to your problem. There's an easy and quick way to find out — ask the Badgerman for his recommendations. Write or phone today. Badger Manufacturing Co., 230 Bent St., Cambridge, Mass.

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BADGER S·R EXPANSION JOINTS

FOR ⅛ TO 1½ INCH BRANCH CONNECTIONS

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CUT

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NEW W-S TeeLet SLASHES TEE COSTS 50% OR MORE!

The new W-S TeeLet replaces conventional Tees of cast or malleable iron, welded or forged steel . . . requires fewer stock sizes. Available in sizes from ⅛ to 1½" IPS, TeeLets are fully machined from forging quality solid steel bars and adapt to run-pipe sizes to 36". They require no additional joint strength calculations for any ASTM A-53 or A-106 Grade B run-pipe of Schedule 40 or 80.

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A W-S TeeLet costs less to buy, less to install than anything you can buy or make. For complete information, prices, and names of distributors, write: *Forge and Fittings Division, H. K. Porter Company, Inc., Box 95, Roselle, N. J.*

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PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Specialty Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION, H. K. PORTER COMPANY de MEXICO, S. A.; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.

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sizes described in bulletin "107"; bulletin lists general specifications and groups them according to case types; also includes mounting dimensions and accessories. *Assembly Products, Inc., 75 Wilson Mills Rd., Chesterland, O.*

▶ *REFRIGERATION PURGING*—bulletin presents data on automatic removal of air from refrigeration systems; bulletin also answers various questions regarding efficient purge methods. *Armstrong Machine Works, 874 Maple St., Three Rivers, Mich.*

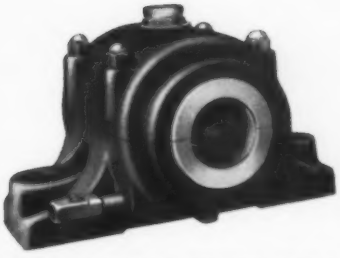
▶ *REMOTE ROOM CONDITIONERS*—available in 200, 300, 400, 600 cfm capacities are illustrated in catalog "381A" containing specifications, heating and cooling capacities, and dimensions. *Acme Industries, Inc., 600 N. Mechanic St., Jackson, Mich.*

▶ *ROOF VENTILATORS*—designed to conform to modern architectural styles; bulletin "V-1759" includes capacity and data tables, specifications and applications. *Bowman Steel Corp., P.O. Box 2129, Pittsburgh 30, Pa.*

▶ *ROOM THERMOSTAT*—of modern appearance featured in bulletin "GED-3585A"; includes performance characteristics, installation and wiring diagrams. *General Electric Co., Schenectady 5, N. Y.*

▶ *SCOTCH BOILER*—for oil or gas firing available in 21 sizes; bulletin "MWB-1" includes table listing all models ratings and dimensions. *Crotty Mfg. Co., 133-15 35th Ave., Flushing, N.Y.*

QUIET



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Exceptionally quiet in operation. Noted for superb quality. Plain and Water Cooled Types. Precision-built, ring-oiling, babbitted. Self-aligning. Can be drilled for thermostatic emergency warning. Shaft sizes from 1-7/16″ to 10″.

DODGE BRONZE BUSHED PILLOW BLOCKS

Designed for Arrangement No. 2 installations. Two bronze bushings of high lead content mounted in one cast iron housing. Special T-section rings for dependable lubrication. Exceptionally quiet in operation. Shaft sizes from 15/16″ to 2-3/16″.

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Designed for Arrangement No. 2 installations. Two precislon single row, deep groove ball bearings in one cast iron housing. Extended inner race carries shaft. Remarkable ease of installation and maintenance. Shaft sizes from 15/16″ to 2-3/16″.

These quality bearings have been developed in close cooperation with manufacturers of fan and blower equipment — to meet the highly specialized requirements of this field.

The nation's great generating plants choose these bearings because of their extraordinary dependability—and the extreme quietness of their operation makes them top choice for air conditioning systems in hospitals, schools, theatres, auditoriums.

Dodge Fan and Blower Bearings are available from stock—with stock-product economy. Consult your local Dodge Distributor—or write us for technical data.

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▸ *SERVICE MANUAL*—covers commercial and industrial air conditioners; includes oil specifications for motor-compressor assemblies, wire and fuse sizes; also has check chart of possible breakdown causes and remedies; contains wiring diagrams of all electrical components. *Embassy Steel Products, Inc., 890 Stanley Ave., Brooklyn 8, N. Y.*

▸ *SLIP-ON FITTINGS*—for pipe sizes from 3/8 to 2 in. discussed in bulletin "K-597"; contains suggestions for design of specific piping applications. *Kee Klamps North America Ltd., 1079 William St., Buffalo 6, N.Y.*

▸ *SMALL CENTRIFUGAL FAN*—used for cooling electronic tubes, ventilating small electronic equipment cabinets, cooling hot spots; bulletin "5812" lists features, dimensional data, performance graphs, specifications. *American Standard Industrial Division, Detroit 32, Mich.*

▸ *SOLAR SCREENS*—and their uses indoors and out to reduce heat gain described in brochure "MFL-559-138" showing six basic patterns. *Malvern Flue Lining, Inc., Malvern, O.*

▸ *SOUND CONTROL*—catalog "60" includes new line of noise reduction panels and new models of air conditioning and ventilating system silencers; provides complete dimensions for all models. *Elof Hansson, Inc., 711 Third Ave., New York 17.*

▸ *STAINLESS TUBING*—properties, sizes, and specifications described in new data card "TDC-195". *Babcock & Wilcox Co., Tubular Products Div., 712 Eleventh St., Beaver Falls, Pa.*

▸ *STEAM COILS*—incorporating new design and dimension changes; catalog "51C9a" includes circuiting selection tables, steam coil selection methods, dimensions and capacities. *Recold Corp., 7550 E. Slauson Ave., Los Angeles 22, Calif.*

▸ *STEAM GENERATORS*—for heating and process using coal described in bulletin "PG-59-4"; generators available in sizes to 63,000 lb of steam per hr with pressures up to 250 psi, includes detail of units components, construction, performance characteristics. *Foster Wheeler Corp., 666 Fifth Ave., New York 19.*

▸ *STEAM GENERATORS*—features outlined in new bulletin "3000" including design and construction; bulletin "3005" gives dimensions, engineering data; "3010" has specifications; "1600" provides information on boiler accessory equipment. *Preferred Utilities Mfg. Corp., 41 E. 42nd St., New York 17.*

Low cost gas burner outstandingly efficient at all flame settings

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Once set, the burner maintains this setting automatically regardless of weather. Sizes from 720,000 to 21,000,000 BTU. Hev-E-Oil and combination gas/oil models also available. For more information write Industrial Combustion, Inc., 4507 N. Oakland Ave., Milwaukee 11, Wis., Dept. HPA-1159.

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the zone control valve with

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for positive temperature control!

Globe-type construction of Zonvalve guarantees complete shut-off on steam, hot and chilled water systems. This means positive temperature control, without heat waste.

Engineer-architects and heating men recognize the superiority of Zonvalve's design features. Self-aligning plug insures positive closure and eliminates jamming. Valve is powered by a heavy-duty motor, with pinion, gear and cam assembly—for extra-long life and silent, dependable operation. Zonvalve's "hand-size" compactness makes installation possible where space is limited. Zonvalve is the *only* valve that uses Teflon for a self-lubricating, permanent seal.

Zonvalve is competitively priced. Built to last a lifetime, *it is the only zone control valve with an unconditional written Five-Year Guarantee!*

Zonvalve is ideal for modernization and new construction, in residential, commercial and industrial zone heating. For the finest in zone control equipment—specify Zonvalve, install Zonvalve!

New color brochure contains layouts, applications, customer benefits, technical data and prices. Write for Brochure P-11.

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AVAILABLE IN SIZES FROM ½" TO 1¼"

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▸ *STEEL TUBING*—in nominal sizes from ¼ to 3 in. described in new technical bulletin; discusses applications and types for various uses. *Standard Tube Co., 21400 Plymouth Rd., Detroit 39, Mich.*

▸ *SUBMERSIBLE MOTORS*—for 4 in. and larger well pumps in new fact sheet; includes availability chart listing unit capacities from 1½ to 40 hp; contains cut-away detailed illustrations of two basic models. *Franklin Electric Co., Inc., 345 E. Spring St., Bluffton, Ind.*

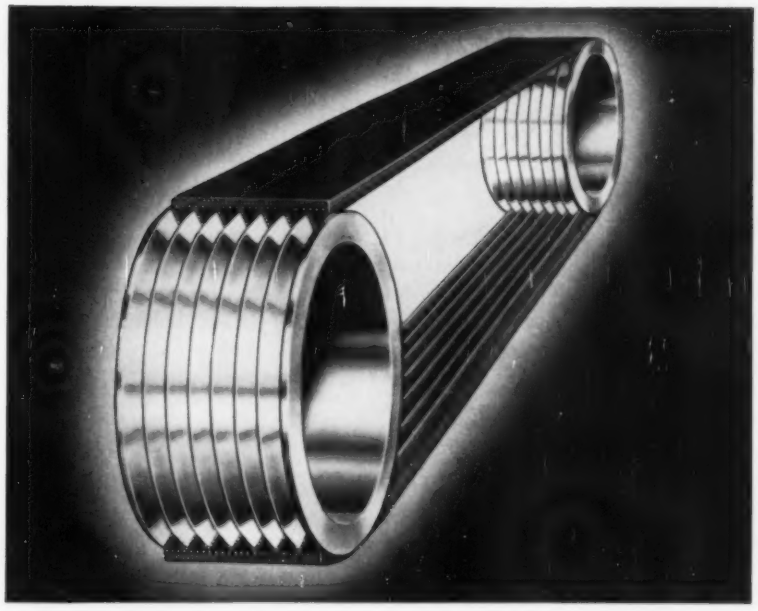
▸ *THERMISTOR PROBES*—in two models detailed in new catalog sheets; one is specification listing for 21 ranges of −50 F to 300 F offered by each model, second sheet gives half scale reproduction of meter scale plates. *Yellow Springs Instrument Co., Inc., Yellow Springs, O.*

▸ *THREE-PASS BOILER*—for large installations described in new bulletin; dimensions and capacity chart lists specifications of 16 sizes of boilers; includes ratings and full diagrams. *Portmar Boiler Co., Inc., 193 Seventh St., Brooklyn 15, N.Y.*

▸ *TUBE FITTINGS*—shown in photographs and drawings in new catalog illustrating flare tube fittings, straight thread and hydraulic tube fittings, and hydraulic accessories. *Lenz Co., Dept. 63-A, 3301 Klepinger Rd., Dayton 16, O.*

▸ *TURBINE PUMP MOTORS*—for outdoor service; bulletin "F-1953" includes design features, cut-away illustrations of motor, full explanation of new lubrication system. *U.S. Electrical Motors Inc., P.O. Box 2058 Terminal Annex, Los Angeles 54, Calif.*

MORE POWER...*LESS* SPACE
R/M POLY-V® DRIVE



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For industrial air conditioning blowers, pumps and compressors—wherever heavy duty power driven equipment is required—*no* drive can deliver as *much* power in as *little* space as Raybestos-Manhattan's patented Poly-V Drive! A single, endless, parallel V-ribbed belt runs on sheaves specially designed to mate precisely with belt ribs. Single unit design permits *narrower* Poly-V sheaves to deliver *equal* power in as little as ⅔ the space of a conventional V-belt drive—or up to 50% *more* power in the *same* space! Space-saving Poly-V Drive reduces shaft overhang . . . eliminates excessive vibration, belt and sheave wear and noise. Poly-V Belt cannot sink into the sheave grooves under shock loads . . . maintains constant speed ratios for smoother, cooler, quieter running performance, *no* load to *full* load.

Major causes of V-drive trouble are engineered *out* of Poly-V. V-belt "length matching" problems are completely eliminated . . . and just *two* Poly-V belt cross sections meet every heavy duty power requirement. Let an R/M representative show you how R/M Poly-V* Drive can give you greater vibrationless power delivery, greater drive dependability for your air conditioning, heating equipment applications. Write for Bulletin M141.

*Poly-V is a registered Raybestos-Manhattan trademark. Patented.

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Precision engineered expansion joints overcome pipe expansion stress, insulate against noise and vibration, avoid misalignment.

- MAXIMUM RESISTANCE TO SHOCK
- GREATER RECOVERY FROM MOVEMENT
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For heavy industrial multiple belt units.

- PRECISION MADE
- SMOOTHEST RUNNING V-BELTS MADE
- MORE GRIP, LESS SLIP
- LONGER, TROUBLE-FREE SERVICE
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NEW R/M CX V-BELT*

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- FOR SMALL PULLEYS
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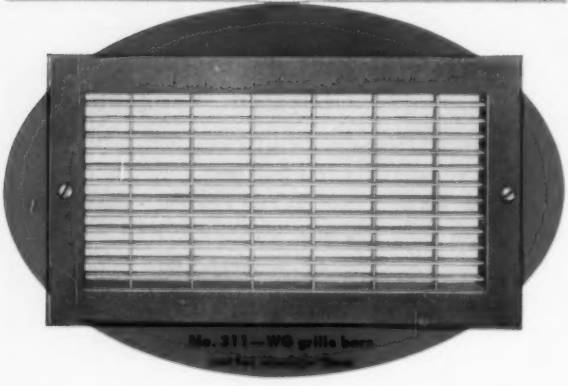
No. 311—D-WG grille bars set at approximately 35° down



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In these grilles, the openings are ⅛" x 1 11/16". Interior grille bars are ½" deep. Outer rims up to vertical 12-inch sizes inclusive are 11/16" wide beyond wall openings on all four sides. On sizes over 12-inch vertical, outer rims are 1 1/32" wide on all four sides beyond wall opening size. Approximate depth of all grilles is ¼". Narrower or wider rims available on special order at moderate additional cost.

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RECENT TRADE LITERATURE

Continued

▸ *TURBINE PUMP MOTORS*—permitting adjustment of pump impellers without shaft disassembly; this feature is illustrated and explained in bulletin "F-1975" along with cross-section diagrams of motor and explanation of other design features. *U.S. Electrical Motors Inc., P.O. Box 2058, Terminal Annex, Los Angeles 54, Calif.*

▸ *TURBINE PUMPS*—in capacity range up to 150 gpm, pressures to 300 psi, and temperatures to 275 F; bulletin No. "S-111" describes design features, gives dimensions, selection tables, limitation charts, construction specifications. *Aurora Pump Div., New York Air Brake Co., Loucks St., Aurora, Ill.*

▸ *UNIT VENTILATOR CONTROL SYSTEMS*—new manual gives control applications; covers all makes and models of unit ventilators; gives cycles of operation, damper sequence charts, installation data, specifications. *Barber-Colman Co., 1300 Rock St., Dept. 763, Rockford, Ill.*

▸ *VACUUM EQUIPMENT* used to reclaim, process and convey materials described in new folder; outlines range of standard models, gives typical applications and illustrates special units for hazardous applications. *Invincible Vacuum Cleaner Mfg. Co., Dover, O.*

▸ *VALVES*—illustrated in wall chart form for installation and maintenance personnel requisitioning valves; chart also tells uses for basic valve types. *Lunkenheimer Co., Waverly and Beekman St., Cincinnati 14, O.*

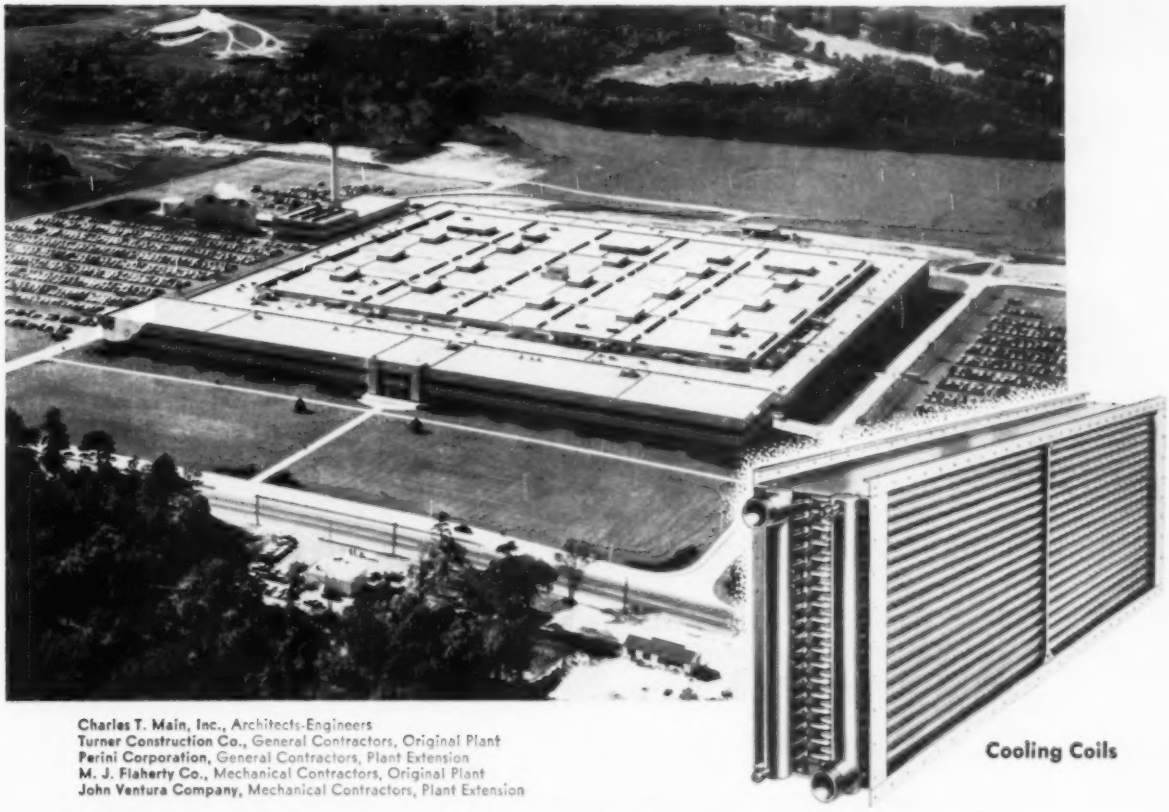
▸ *VALVES AND FITTINGS*—for instruments equipped with lens-ring gaskets and union-type joints described in bulletin No. "4072"; contains listings of complete valve and fitting line as well as design and application suggestions. *American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.*

▸ *VALVE MOTORS*—with yoke assembly in specification "S1016-2" which includes motor data and features, force ratings. *Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.*

Western Electric Company

NEW MERRIMACK VALLEY WORKS

32 Acres of Floor Space



Charles T. Main, Inc., Architects-Engineers
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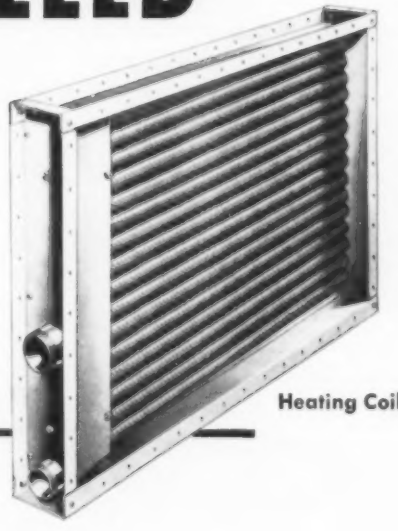
Modern smooth-fin design of Aerofin coils permits ample heat-exchange capacity in limited space — permits the use of high air velocities without turbulence or excessive resistance.

Aerofin performance data are laboratory and field proved. You can safely specify Aerofin coils at full published ratings.



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AEROFIN CORPORATION

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Aerofin is sold only by manufacturers of fan system apparatus. List on request.

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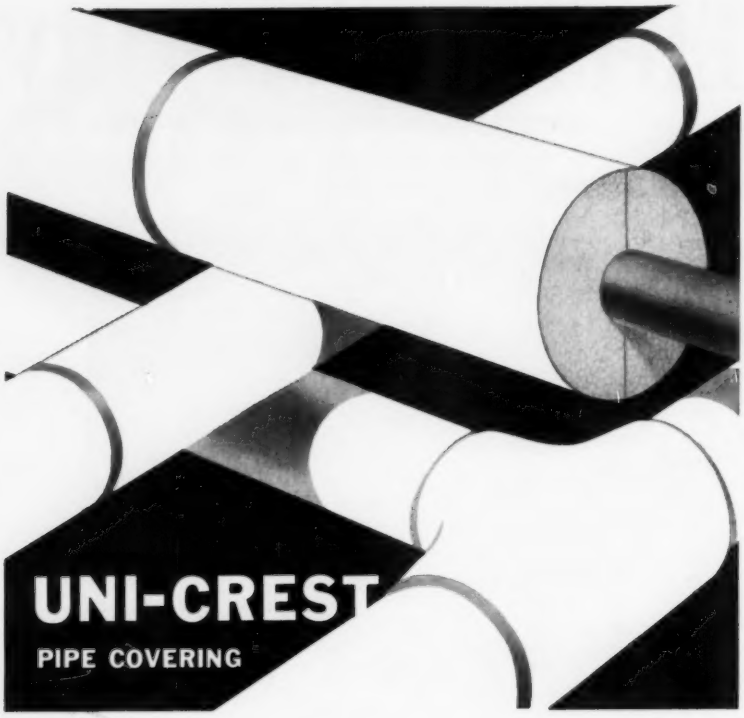

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Uni-Crest expanded polystyrene pipe covering is an excellent low temperature insulating material, and is inexpensive to install and maintain.

Its low thermal conductivity (K factor) plus its high resistance to water and water vapor — are some of its prime qualities. It will not rot, mildew, or support fungus growth.

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▸ *VARIABLE SPEED DRIVES*—in capacities from ¼ through 40 hp with adjustable speeds from 2:1 to 10:1 from a constant rpm a-c motor source; catalog "M-592" contains construction features, specifications, speed and rating tables; catalog may be obtained by request on company letterhead. *Reeves Pulley Div., Reliance Electric and Engineering Co.*, 24701 *Euclid Ave., Cleveland* 17, *O.*

▸ *VENT VALVES*—general catalog now available covering full line of heating products; catalog includes data on flow control valves, vent valves, and pressure relief valves among others. *Dole Valve Co.*, 6201 *Oakton St., Morton Grove, Ill.*

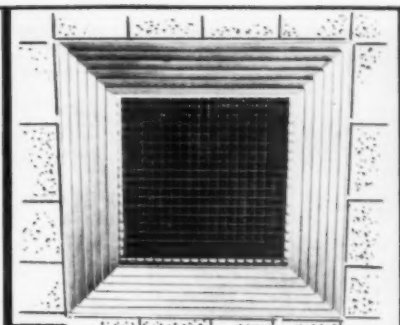
▸ *VIBRATION CONTROL*—manual for use in solving objectionable vibration and shock conditions; contains complete set of reference charts with text discussing new concepts. *Voss Engineering, Inc.*, 5649 *N. Ravenswood Ave., Chicago* 26.

▸ *VIBRATION CONTROL*—data sheet "59-05" presents new system applications and equipment. *Barry Controls, Inc.*, 700 *Pleasant St., Watertown* 72, *Mass.*

▸ *VIBRATION ISOLATORS*—for protection of delicate instruments, engines, compressors, and motor-generators; illustrated in bulletin "59-04" containing selection of graphs. *Barry Controls, Inc.*, 700 *Pleasant St., Watertown* 72, *Mass.*

▸ *WATER TREATMENT*—problems in air conditioning systems covered in bulletin "596" which covers corrosion, scale formation, slime and algae growths; bulletin also contains control testing data and application information. *Betz Laboratories, Inc.*,

1



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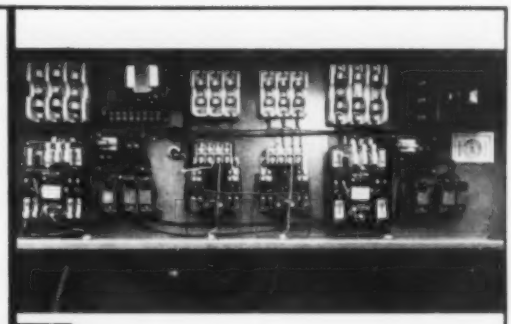

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There's always room on top for the original low silhouette.

1. **MECHANICAL CHIMNEY** assures positive elimination of flue gases and does away with the need for unsightly stacks.

2. **SUPPLY & RETURN AIR DISTRIBUTION CHAMBER** with controlled air pattern is easily adaptable for duct connections in all directions.

3. **MOTOR CIRCUITS** are individually fused on a pre-wired control panel which includes an internally mounted service switch.

4. **ALL COMPONENTS** are totally protected against the elements in a completely weathertight and fully insulated aluminized steel enclosure.

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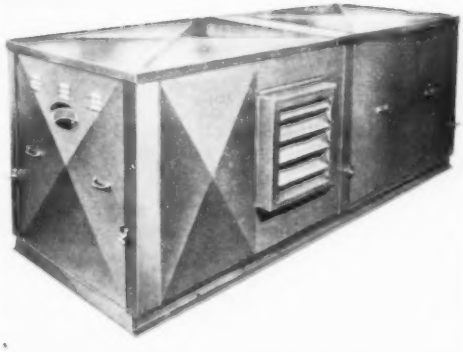

These features — and many others listed in our latest bulletin — belong *exclusively* to the Atmos-Pak . . . THE ORIGINAL roof-mounted, year-round, pre-fabricated air conditioning system available in 10 models of 5 through 35 tons.

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"Hidden" values in

AURORA

CENTRI-PAC PUMPS

provide long term top performance

TYPE BP
CLOSE
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CAPACITIES TO 450 GPM • HEADS TO 140 FT.

22 Packaged Sizes

AIR CONDITIONING EQUIPMENT • CIRCULATING SERVICES
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Quality is that often "HIDDEN" but ever present characteristic in AURORA pumps that provides long-term top performance. It is the sum of design features, experienced material selection, and craftsmanship.

STAINLESS STEEL SEALS for maximum corrosion resistance . . . straight-shaft impeller mounting provides positive impeller-to-shaft lock . . . STAINLESS STEEL MOTOR SHAFT . . . positive drive on seal . . . CAST BRONZE IMPELLER is carefully balanced to insure MAXIMUM SMOOTHNESS AND QUIETNESS . . . vertical discharge provides for SELF-VENTING . . . LOW NPSH.

These "hidden" values make the *difference* in building complete satisfaction and customer acceptance.

You may also select from a complete line of close-coupled horizontal or vertical mounted pumps and flexible-coupled pedestal mounted pumps engineered to your specific requirements.

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RECENT TRADE LITERATURE
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Gillingham & Worth Sts., Philadelphia 24, Pa.

▸ *WATER TREATMENT*—paper describes new types and designs of water treatment plants; available in reprint form as No. "123" with data on rates of flow of scavanger condensate demineralizers. *Cochrane Corp., 17th St., below Allegheny, Philadelphia 32, Pa.*

▸ *WATER TREATMENT*—catalog covering preventives for corrosion and scale; catalog "659" shows 10 sizes and types of feeders and installation diagrams for each. *Calgon Co., Hagan Building, Pittsburgh 30, Pa.*

▸ *WELDING EQUIPMENT*—new manual contains capacity curves for complete model range; also includes charts and technical data on welding accessory items. *Smith Welding Equipment Corp., 2633 Fourth St., S.E., Minneapolis 14, Minn.*

▸ *WELDING FITTINGS*—in 22 in. nominal pipe sizes; bulletin "FDC-271" includes descriptions, dimension, and weight charts as well as diagrams of various types of fittings available. *Babcock & Wilcox Co., Tubular Products Div., Welding Fittings Dept., Milwaukee 46, Wis.*

▸ *WELDING FITTINGS AND FLANGES*—in 20 in. nominal pipe sizes in new bulletin "FDC-270" containing full data on dimensions, weight, types of fittings available. *Babcock & Wilcox Co., Tubular Products Div., Welding Fittings Dept., Milwaukee 46, Wis.*

▸ *WELDING FITTINGS AND FLANGES*—in 14 in. nominal pipe

RECENT TRADE LITERATURE

Continued

sizes in new bulletin "FDC-267" containing full data on dimensions, weight, types of fittings available. *Babcock & Wilcox Co., Tubular Products Div., Welding Fittings Dept., Milwaukee 46, Wis.*

▸ *WELDING MACHINES*—illustrated in catalog "EW-209" including specifications on gasoline and diesel engine driven welders, electric motor driven arc welders, rectifier type welders, transformer type welders, a-c/d-c inert gas shielded arc welders, and other welding equipment. *Hobart Brothers Co., Troy, O.*

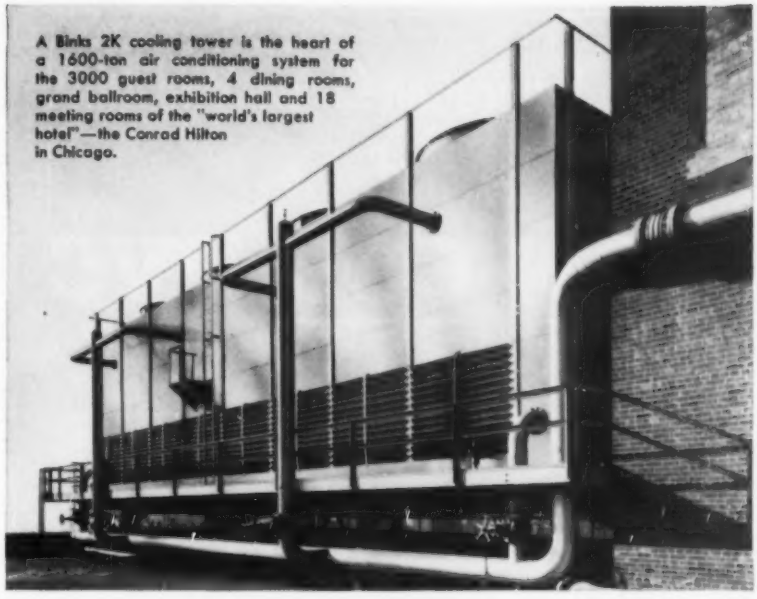
▸ *WELDING POWER SOURCES*—in bulletin "ADR 121" offers comprehensive guide to proper selection of a-c welders for gas shielded tungsten-arc, or gas shielded metal arc welding processes. *Air Reduction Sales Co., 150 E. 42nd St., New York 17.*

▸ *ADHESIVES, COATINGS*—booklet No. "2" includes product descriptions and technical bulletin on standard line of products; also contains suggested applications. *H. B. Fuller Co., 255 Eagle St., St. Paul 2, Minn.*

▸ *BRANCH FITTINGS*—booklet describes applications and benefits; covers engineering design data, points of practical use. *Forge and Fittings Div., H. K. Porter Co., Inc., P.O. Box 95, Roselle, N.J.*

▸ *BOILER WATER TREATMENT*—technical bulletin "597" lists causes of priming and foaming troubles; also suggests means of prevention and cure. *Water Service Laboratories Inc., 615 W. 131st St., New York 27.*

▸ *CLAY PIPE HEATING DUCTS*—brochure details design features and information; also included are construction data, diagrams of various construction methods, installation details. *Texas Vitrified Pipe Co., Mineral Wells, Texas.*



A Binks 2K cooling tower is the heart of a 1600-ton air conditioning system for the 3000 guest rooms, 4 dining rooms, grand ballroom, exhibition hall and 18 meeting rooms of the "world's largest hotel"—the Conrad Hilton in Chicago.

CONRAD HILTON HOTEL, CHICAGO

Saves $75,000 a year on water with Binks 2K cooling tower

"In 1956 we installed a Binks 2K cooling tower. It is more than paying its own way," reports Mr. H. M. Toombs, chief engineer for the Conrad Hilton Hotel, Chicago.

Only 5% daily make-up

"On a one-pass basis our 1600 ton air conditioning system would use six million gallons of cooling water daily. Instead we recycle 8600 gallons and our actual consumption is about 430 gallons daily through evaporation or drift. The efficiently balanced air-to-water ratios and counter air-water flow lowers entering water from 95° F to 85° F before it is returned to the condenser."

Maintenance savings

"In addition to water savings, the corrosion-resistant features of the Binks 2K tower will provide substantial savings in maintenance, also. The structural framing is hot-dipped galvanized after forming. Casing sheets of 16 gauge steel are also heavily galvanized and the four 120-in. fans are of aluminum alloy."

Big job or small—call Binks

Binks towers offer you complete selection flexibility for every air conditioning or industrial process cooling need. Bulletins 333 and 478 describe these towers. Ask your Binks Branch Office for a copy. There is no obligation.

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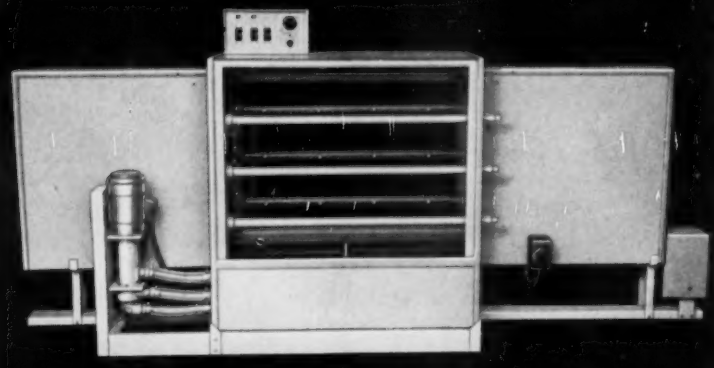
Unique Fabrication Shows Versatility of VAN-COR PVC



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To resist acid corrosion, this etcher is primarily made of Van-Cor PVC pipe, fittings, (standard and specially machined), valves, sheet (transparent and regular), and joining strips.

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Van-Cor PVC has many applications for plant use, or in your end product. It is ideal for plating equipment, filters, flux spray booths, chemical treatments, bleaching operations, glass polishing, and corrosive fume handling in general.

ADVANTAGES OF VAN-COR

1. Resists Corrosion of Industrial Acids & Alkalies
2. Light in Weight (½ that of Aluminum)
3. Easily Installed; High Tensile Strength; Low Flow Resistance
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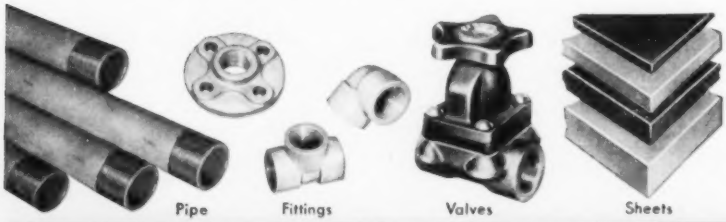

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COLONIAL PLASTICS MFG. CO.
Subsidiary of THE VAN DORN IRON WORKS CO.
2685 EAST 79TH STREET CLEVELAND 4, OHIO

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▸ *COOLING TOWER*—winter operating procedures described in technical bulletin "598" including steps to follow in avoiding freeze-ups; includes procedures in preventing parts of system exposed to cold air from freezing. *Water Service Laboratories, Inc.*, 615 *W.* 131*st St., New York* 27.

▸ *DEAERATING HEATERS*—of spray type discussed in bulletin "WC-101C" including principles of deaeration, deaerator operation, standard designs available, design features and accessory equipment. *Graver Water Conditioning Co.*, 216 *W.* 14*th St., New York* 11.

▸ *EXHAUST HOODS*—illustrated in new bulletin "270-E2A" detailing operation; includes application illustrations and ventilation data; descriptive information about typical foundry dust control system and explanation of operation of different dust control equipment in foundries included. *American Air Filter Co. Inc., Dept. PD*, 215 *Central Ave., Louisville* 8, *Ky.*

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with these dependable
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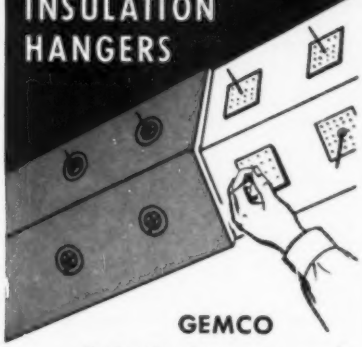

GEMCO
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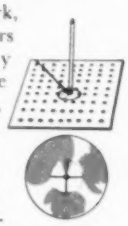
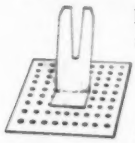
Ideal for insulation work, Gemco Spindle Hangers are easily and quickly installed... with positive adhesion to concrete, brick or metal. W-A Self-Locking Washers pressed over spindles with minimum effort and lock insulation securely in place.



GEMCO Pronged Hangers



Designed especially for supporting various types of block insulation. Easily applied for positive adhesion. Prongs (available in various lengths from 1 3/16" to 6 7/8") bend over to hold insulation firmly in place.

TUFF-WELD Nylon Hangers

Two-piece hangers... with bases of tough, mold nylon and spindles of metal. Made especially for smooth surfaces. Spindles snapped into bases as needed; reduces inventory, storage space, freight costs. W-A Self-locking washers hold insulation securely in place.

TUFF-BOND Quik-Set Adhesive (for smooth or slightly irregular surfaces) and Improved General Purpose Adhesive (for rougher surfaces) assure permanent adhesion of hangers when used as directed. Write or wire for details and specifications.

GOODLOE E. MOORE
INCORPORATED
DANVILLE 28, ILLINOIS

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▸ *FUME HOOD*—uses covered in booklet No. "35E"; includes glossary of terms; illustrations and lists of recommendations for different types of fume hoods; comprehensive description of approved method of fume hood testing; operating and safety precautions. *Kewaunee Mfg. Co., 5123 S. Center St., Adrian, Mich.*

▸ *MASONRY ANCHORING*—handbook includes tables showing proper anchors to be used with each type of fixture and material; contains dimensions and specifications for each type of anchor and drill. *Rawplug Co., Inc., 200 Petersville Rd., New Rochelle, N.Y.*

▸ *MOTOR CONTROLS*—digest with descriptive technical and engineering information; includes reference selector guide. *Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.*

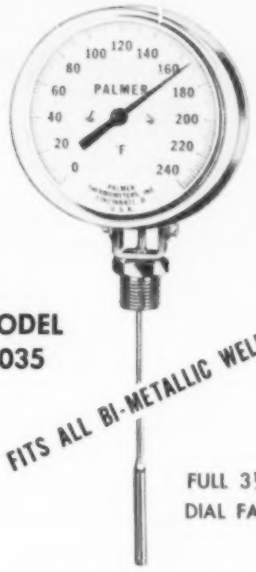
▸ *PACKAGE BOILERS*—for heating and power described in bulletin "B-3232" with complete wet back construction features illustrated; includes design details, specifications, range of sizes. *Titusville Iron Works Co., Div. of Struthers Wells Corp., Titusville, Pa.*

▸ *PRESSURE REDUCING VALVES*—folder featuring single-seat, tight-closure, self-contained construction; includes complete capacity chart, typical installation illustration, applications, description including diagrammatic illustrations, special features. *Atlas Valve Co., 280 South St., Newark 5, N.J.*

▸ *PVC SHEETS*—listing properties and applications for various uses in catalog "RV-59"; included are specifications for products and chemical resistance chart listings. *Kaykor Industries, Inc., Yardville, N.J.*

▸ *RECORDERS*—listed in bulletin "GEA-6933"; bulletin describes specialized recording instruments; includes dimensions, chart speeds, op-

Outstanding
Accuracy
PALMER
Dial Thermometer



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- Direct-drive Bourdon Coil with a filled system for longer lasting accuracy.
- Stem can be placed at any desired angle and case can be rotated to most readable position.
- External calibration for zero setting.
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EASY TO INSTALL AND MAINTAIN!

Installation and maintenance of Whitlock Type R Convertors are greatly simplified because of special design features which are highly approved by consulting engineers. The side outlet water connections and the U-tube bundle which can be readily removed if required are particularly convenient and important in reducing upkeep costs. Also extremely helpful in the field, water connections 5″ and larger are *flanged* as are also all steam connections 4″ and larger.

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Send Bulletin 62 describing Whitlock Type R Convertors.

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erating specifications, applications, features and accessories. *General Electric Company, Schenectady 5, N.Y.*

▸ *RELIEF VALVE*—designed to prevent damage from overpressure in sewage line detailed in bulletin "SEW-1"; bulletin illustrates pipe flow, gives dimensions, capacities. *Golden-Anderson Valve Specialty Co., 1210 Ridge Ave., Pittsburgh 33, Pa.*

▸ *STAINLESS STEEL*—data chart listing comparison of properties of 18 different grades of stainless steel using bar graphs. *Peter A. Frasse & Co., 17 Grand St., New York 13.*

▸ *STRAIN GAGE*—bulletin No. "2294" contains information on operating system, applications, ordering information for both standard and

CANCER'S DANGER SIGNALS CAN BE SAFETY SIGNALS

You can do **two things** to guard yourself against cancer: Have an annual health checkup. Alert yourself to the seven danger signals that could mean cancer: **1.** Unusual bleeding or discharge. **2.** A lump or thickening in the breast or elsewhere. **3.** A sore that does not heal. **4.** Change in bowel or bladder habits. **5.** Hoarseness or cough. **6.** Indigestion or difficulty in swallowing. **7.** Change in a wart or mole. If your signal lasts longer than two weeks, go to your physician. Give him the chance to give you the chance of a lifetime.

AMERICAN CANCER SOCIETY

RECENT TRADE LITERATURE
Continued

high temperature strain gages. *American Instrument Co., Inc.*, 8030 *Georgia Ave., Silver Spring, Md.*

▸ *STEAM HEAT COILS*—bulletin No. "HC-102" describes construction and operation for standard steam, hot water, steam distributing and double distributing coils; includes construction and dimension data, air friction charts, temperature rise charts, specifications. *American Air Filter Co., Inc.*, 215 *Central Ave., Louisville* 8, *Ky.*

▸ *VALVES*—of globe, angle, check and gate types shown in folder "1443-V" listing types, sizes, types of pipe ends, pressure ratings. *Ohio Brass Co.*, 380 *N. Main St., Mansfield, O.*

▸ *WATER CONDITIONING*—data sheet covering bacterial fouling, deposits encountered; table of characteristics of cation exchange materials. *Betz Laboratories, Inc., Gillingham & Worth Sts., Philadelphia* 24, *Pa.*

▸ *WATER HEATERS*—bulletin "4" gives design and operating features of new indirect gas fired heater; included are practical applications of thermal design principles, standard weights, capacities, dimensions. *Patterson-Kelley Co., Inc., East Stroudsburg, Pa.*

▸ *WELDING FITTINGS AND FLANGES*—in nominal 24 in. pipe sizes detailed in new technical bulletin "FDC-272"; bulletin contains charts of descriptions, dimensions, weights, diagrams of various types of fittings. *Babcock & Wilcox Co., Tubular Products Div., Welding Fittings Dept., Milwaukee* 46, *Wis.*

▸ *WELDING WIRES*—pocket guide catalog "ADC 873A" gives information on gas-shielded metal-arc welding wires; contains information on chemical composition, mechanical properties, operating procedures, wire diameters. *Air Reduction Sales Co.*, 150 *E.* 42*nd St., New York* 17. ≠

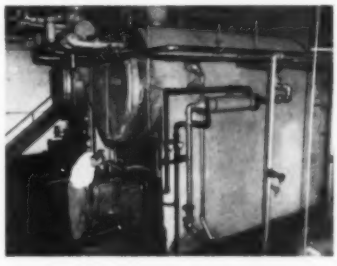
25-Year Exclusive User Again Selects Enterprise Burners

"Performance made choice easy,"

Says University Towers President

"There was never any doubt as to the make of oil burners we'd install in University Towers, our three new 15-story apartment buildings in Brooklyn," says Benjamin Neisloss, president. "Experience during the 25 years we've used them exclusively in our other apartment buildings proved Enterprises to be top performers—unusually economical, trouble-free and efficient."

This choice of additional Enterprise burners by a long-time user is typical of scores of such installations we make each year. Whatever your heavy duty commercial or industrial application, look to Enterprise for the finest in a complete range of oil and combination oil and gas burners from 4 to 200 gph. Complete information and illustrated specification sheets available on request.



Abundant, dependable, economical heat for the 549 family units in the huge University Apartments, Brooklyn, N.Y., is supplied by 6 Pacific Loset boilers fired by 6 Enterprise J3-P fully automatic oil burners. Installation was made by Enterprise Engineering Co. Inc., Brooklyn, N.Y.

The Choice of Heating Experts

ENTERPRISE

DEPENDABLE BURNERS

ENTERPRISE ENGINE & MACHINERY CO. • 18TH AND FLORIDA STS., SAN FRANCISCO, CALIFORNIA

Contractors Report Savings up to 40%

Use Miracle NP555 to seal spiral conduit and fittings Efficiently and Economically

Miracle NP555 is a specially formulated duct sealer with excellent aging properties, resulting from use of non-oxidizing raw materials. NP555 has been custom made to **effect substantial economies for you — savings of up to 40% have been reported from many sheet metal contractors who have used this sealer!**

NP555 Duct Sealer has excellent shelf life, and rarely has to be thinned. It's a pleasure to work with NP555 because of the mild solvents it contains. NP555 Duct Sealer creates a tenacious bond to metal, and provides a sure permanent seal around seams. Use NP555 between all sections of spiral conduits and fittings — between risers and run-outs — between run-outs and air conditioning units.

ON REQUEST:
Send today for additional information!

CONSTRUCTION BY ADHESION

MIRACLE ADHESIVES CORPORATION
250 Pettit Avenue, Bellmore, L. I., N.Y.

WHO'S WHAT

▸ *CRUCIBLE STEEL CO.*—Maurice J. Day, vice president of technology; George W. Stamm, vice president of sales; Walter E. Gregg, director of technology.

▸ *EUTECTIC WELDING ALLOYS CORP.*—John P. Broderick, supervisor of technical services dept.; Richard O. Drossman, sales supervisor in Pennsylvania, West Virginia, western Maryland; Gordon L. Philips, sales supervisor in New Jersey, Delaware, Philadelphia, Baltimore, eastern Maryland; Howard M. Gans, sales supervisor, Bronx and Westchester counties, New York.

▸ *CHESTER CABLE CORP.*—James Henderson, plant superintendent.

▸ *AMERICAN GAS ASSOCIATION*—president, Wister H. Ligon, president and director of Nashville Gas Co.; first vice president, Lester T. Potter, president of Lone Star Gas Co.; second vice president, Edward H. Smoker, president of United Gas Improvement Co.; treasurer, Vincent T. Miles, treasurer of Long Island Lighting Co.

▸ *A. Y. McDONALD MFG. CO.*—A. L. Sachs, chief product engineer.

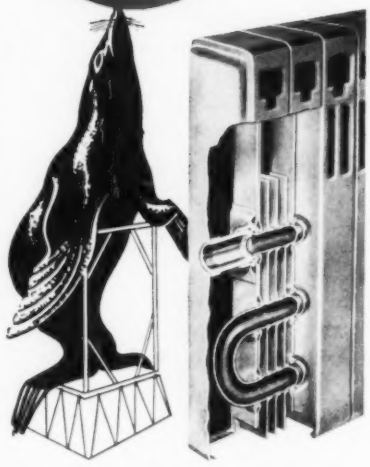
▸ *ILLINOIS SOCIETY OF PROFESSIONAL ENGINEERS*—Ralph Abramson, chairman of public relations committee.

▸ *NATIONAL ELECTRICAL MFG. ASSN.*—chairman of room air conditioner section, C. W. Paulson, manager, room air conditioner dept., Westinghouse Electric Corp.

▸ *COBELL INDUSTRIES, INC.*—R. E. Hempel, chief engineer; Leon Bowen, project engineer.

▸ *ALLIS-CHALMERS MFG. CO.*—J. M. Duncan, manager, industries group; B. G. Camp, manager, Atlanta district.

ONLY SHAW radiators deliver radiant and convected heat Properly Balanced ★



Shaw Panel Radiators distribute a carefully engineered combination of radiant and convected heat that only Nature, at her best, can rival.

Shaw's health-guarding proportions of radiant and convected heat will not vary regardless of hot water or steam temperature. There is no stratification—heat is distributed evenly throughout the room.

Investigate Shaw Panel Radiators. They are rugged, self-contained steel and copper units, of one-piece-bonded construction, easy to handle and install. Heights are 8" to 26"; lengths 11" to 111". Choice of same end or opposite end tapping on all models facilitates piping economies and proper radiator location. Write today for full information.

SHAW-PERKINS MANUFACTURING COMPANY
201 East Carson St. • Pittsburgh, Pa.

WHO'S WHAT

Continued

▸ *BABCOCK & WILCOX CO.*—F. H. Foglesong, manager of alloy sales.

▸ *NATIONAL BUREAU OF STANDARDS*—Bruce L. Wilson, chief of engineering mechanics section.

▸ *CARRIER CORP.*—Roy Lansing, business manager, unitary equipment division western region; Richard K. Chapman, Chicago district manager, unitary equipment division; Herbert E. Miller, Philadelphia district manager, unitary equipment division.

▸ *BARRY CONTROLS, INC.*—A. S. Chivers, manager of Watertown division; Russell Lowe, manager of western division.

▸ *ANEMOSTAT CORP.*—William F. Peters, general sales manager.

▸ *BAILEY METER CO.*—P. O. Newell, resident engineer in Tulsa, Okla.

▸ *KORFUND CO., INC.*—Francis G. Kirschner, chief engineer, acoustical div.

▸ *CARLON PRODUCTS CORP.*—Even T. Collinsworth, Jr., president; William Abramowitz, chairman of board; Brigham Britton, chairman of executive committee.

▸ *AURORA PUMP DIV., AMERICAN BRAKE SHOE CO.*—Raoul D. Elder, division sales manager.

▸ *READING TUBE CORP.*—Maurice M. Rosen, director.

▸ *AMERICAN STANDARD INDUSTRIAL DIV.*—Albert O'B. Andrews, president.

HYDROTHERM

PACKS A 20% GAS SAVING HERE

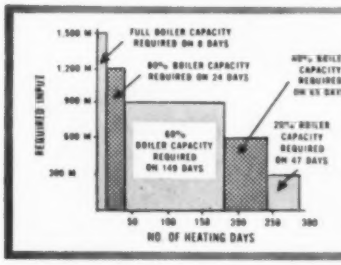
Here's where MultiTemp reduces gas costs by 20%. Return header has independent, differentially set aquastats that trigger each boiler, modulate input, and eliminate short cycling waste.

New MULTITEMP SYSTEMS

Make Gas Heat Competitive on "BIG JOBS"

Now even the big jobs requiring up to 3,600,000 BTU/hr input can enjoy the convenience and cleanliness of gas heat. A Hydrotherm MultiTemp system achieves true input modulation, brings gas consumption down and, being composed of multiple units, insures against service interruptions.

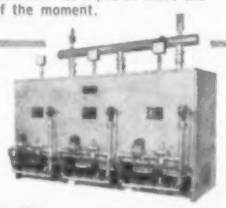
A MultiTemp battery of Hydrotherm boilers is hooked up with a separate aquastat for each boiler in the common return header. With each aquastat set for a different temperature, the boilers are fired or cut off independently. When the demand is small, only one boiler operates... when it is great or when the system is making a cold start, the complete heating plant is fired.



This graph shows the year-round load for a 1,500,000 BTU/hr hydronic plant in Bergen County, N. J., where degree days average 5600 to 6000. Heat was required for 293 days, but full capacity was needed for only 3% of that time.

Note how a single 1,500,000 BTU/hr boiler would have short cycled for 89% of the heating season at a great loss in efficiency. Note also how the MultiTemp battery of five 300,000 BTU/hr boilers modulated its input to meet the heating demand of the moment.

- **Input Ratings from 360,000 to 3,600,000 BTU/hr**
- **100 lbs. ASME Working Pressure**
- **Boilers Shipped Pre-Wired and Assembled**
- **Units Pass Thru 2'6" Doors**
- **Ideal for Volume Hot Water**



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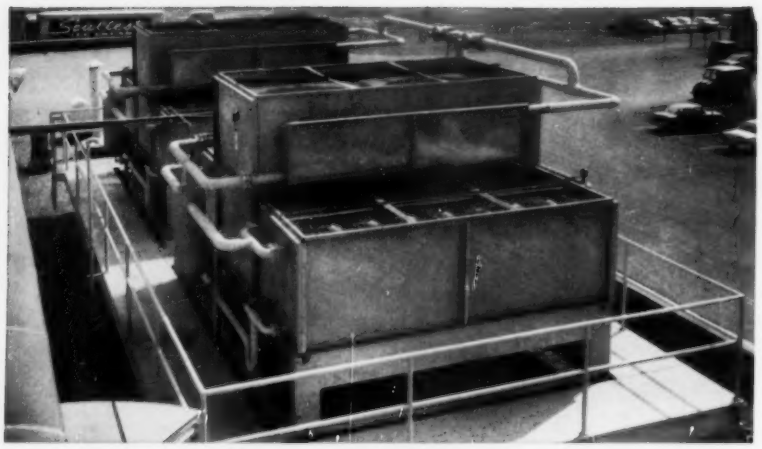
HYDROTHERM INC

DEPT. 13-AC NORTHVALE, NEW JERSEY

OTHER FAMOUS HYDROTHERM PRODUCTS: HydroTherm • HydroVector • HydroChiller • HydroFin



MODERN NIAGARA CONDENSERS PAY FOR THEMSELVES IN EXTRA SAVINGS

These Niagara condensers are lower in first cost and assure you of trouble-free automatic refrigeration. Special features: "Aeropass" coil removes super-heat to give you condensing at lower temperatures and prevent loss of capacity by the scaling of condenser tubes; "Oil-out", oil separator between pre-cooling and condensing coils gives you always an oil-free system; "Panel-Casing" construction gives you access to every part of the condenser for inspection and maintenance. Operating engineers say these condensers "save half the work of running a refrigerating plant". Managers who know costs and profits prove that Niagara condensers bring them great returns in power savings, water savings and reduced maintenance expense.

Write for Bulletins 131 and 142.

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Dept. HP-11, 405 Lexington Ave., New York 17, N. Y.
Niagara District Engineers in Principal Cities of U. S. and Canada

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FINNED TUBING for Heating and Cooling

. . . The Greater-Heat-Transfer, Extended-Surface Tubing

★ known for performance since 1915 ★

- Tubes & Coils
- Individual finned tubing in standard sizes, square or round fins of any height or spacing
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- Single pass, header-to-header
- Simple to install
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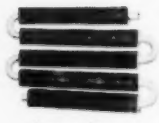
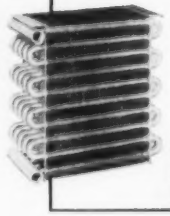
Individual Fin Tubing


Square Fin, Continuous, Return Bend Coil

Square Fin, U-Bend Tubing

Unit Heater Coil


Continous Strip Fin, All-Aluminum Cooling Coil

"to transfer heat, G & O can't be beat"

THE G&O MANUFACTURING CO.
139 Winchester Avenue New Haven 8, Conn.
1420 Ridgeway Street Jackson, Miss.

WHO'S WHAT

Continued

▸ *BALTIMORE AIRCOIL CO.*—W. Donald Geiser, production manager; George E. Klein, assistant production manager; Thomas E. Facius, chief engineer.

▸ *AMERICAN AIR FILTER CO.*—Frank K. Platt, assistant to manager of school air systems division; Dale D. Briggs, supervising sales engineer, Pacific region; Frank T. Carroll, sales manager, school air systems division; W. H. Fogarty, sales manager for Illinois engineering products.

▸ *CRANE CO.*—Donald J. Quinn, director of public relations.

▸ *WAGNER ELECTRIC CORP.*—George W. Brown, president and chief executive officer.

▸ *YORK-SHIPLEY, INC.*—Charles M. toeLaer, division manager; Richard J. Hoover, general sales manager; both with Jackson & Church Division.

▸ *JOSEPH T. RYERSON & SON, INC.*—Allan F. Eggleton, manager of sales of alloy, stainless, cold finished carbon tubular steel.

▸ *ARMSTRONG RESEARCH AND DEVELOPMENT CENTER*—F. B. Menger, director of research; R. B. Rohrer, associate directors research.

▸ *ELGEN MFG. CORP.*—Robert B. Alexander, sales manager.

▸ *WARREN WEBSTER & CO., INC.*—Andrew Ward, vice president of marketing.

▸ *H. H. REICH CONSULTING ENGINEERS*—David C. Jack, Jr., chief designer, mechanical systems.

WHO'S WHAT

Continued

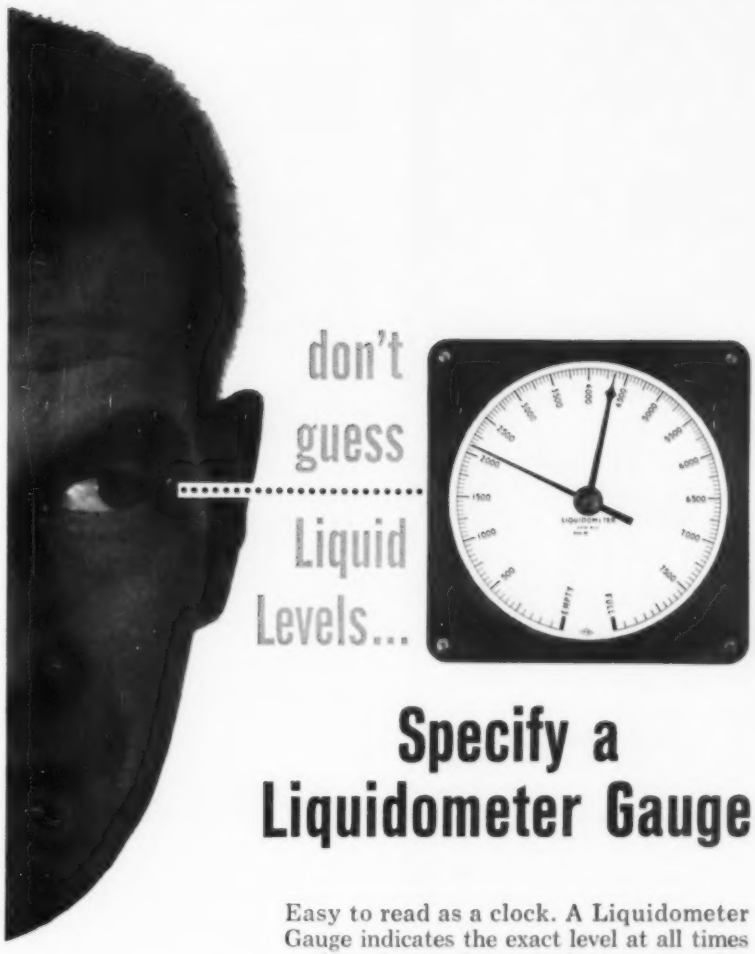
▸ *YOUNGSTOWN SHEET & TUBE CO.*—Maurice P. Rees, district sales manager; J. Paul Tierney, superintendent of rod, wire & conduit depts., Struthers plant; Walter J. Prochak, superintendent of cold drawn bar dept., Brier Hill Plant; Robert G. Griffith, superintendent, seamless tube mills, Campbell works; Glyn Roberts, superintendent of property protection dept.; Marcus V. Appleman, asst. superintendent, open hearth dept., Campbell works.

▸ *WORTHINGTON CORP.*—George H. Salesky, Jr., manager of purchasing of air conditioning and refrigeration division; Peter A. McLeod, field sales manager of air conditioning and refrigeration division.

▸ *NATIONAL ELECTRICAL MFR. ASSN.*—chairman of adsorption section, R. R. Goll, manager of Dryer Div. C. M. Kemp Mfg. Co.; vice chairman of adsorption section, G. R. Feeley, president, Trinity Equipment Corp.; chairman, education committee, Anthony Hass, president, Dryomatic Corp.; chairman, technical requirements of government specifications, O. D. Colvin, president, Carocaire Engineering Corp.; chairman, statistical committee, G. C. F. Asker, vice president, Desomatic Products, Inc.

▸ *CENTRAL SUPPLY ASSN.*—president, Ralph V. Cook, president-general manager of Cook Supply Co.; 1st vice president, John Robertson, Robertson Heating Supply Co.; 2nd vice president, Harold T. Davisson, Southwest Supply Co.; treasurer, Paul Aronhalt, Topeka Supply and Boiler Co., Inc.; honorary president, H. B. Houlihan, Missouri Water and Steam Supply Co.

▸ *WATERLOO REGISTER CO., INC.*—Richard E. Nemmers, sales manager.



Specify a Liquidometer Gauge

Easy to read as a clock. A Liquidometer Gauge indicates the exact level at all times ...shows it at a glance. And gauge operation is completely automatic—as far as 250 feet from the tank—without need for auxiliary power of any kind.

A Liquidometer Tank Gauge measures virtually any liquid. It's simple to install—requires no maintenance. Many have provided over 30 years of efficient, dependable service. All are approved by Underwriters' Laboratories and Factory Mutual.

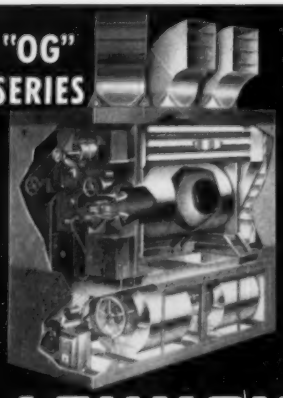
Whether your gauging needs require an automatic Liquidometer Gauge, a hydrostatic Levelometer or a tank-site-indicating Direct Reader, you'll get the best by specifying Liquidometer. For complete details write Dept. A.

Since 1920 ...of proven quality

THE LIQUIDOMETER CORP.

LONG ISLAND CITY 1, NEW YORK

"OG" SERIES



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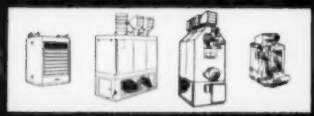
GAS...OIL...OR NEW TYPE

Dual Fuel

POWER BURNERS

Combination burners are available for the "OG-4," and are interchangeable with single fuel burners. All burners are of the same general construction; switching from dual fuel to a single fuel burner involves changing only one or two minor parts. On all burners the combustion air is pre-heated. "Push button" changeover from one fuel to another and electric gas ignition give added ease of operation and safety to the combination burners. Write today for the full story.

LENNOX "Task Matched" Equipment to control and condition air for industry



64,000 to 2,000,000 Btuh Units

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INDUSTRIAL DIVISION
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Please send me—without obligation—complete specifications and engineering data on Lennox "OG" Series Industrial Heaters

Name_____

Company_____

Address_____ City_____

Title_____

WHO'S WHAT

Continued

▸ *WOLVERINE TUBE DIV. OF CALUMET & HECLA, INC.*—L. A. Brewer, to develop plans for marketing new tubular products.

▸ *PENN CONTROLS, INC.*—H. M. Carnahan, vice president, director of sales; George S. Myers, vice president, director of manufacturing.

▸ *E. I. du PONT de NEMOURS & CO.*—Dr. Frank E. French, Jr., manager of new product and market development.

▸ *PITTSBURGH PLATE GLASS CO.*—Walter D. Snyder, general manager of operations for merchandising division; James C. Plunkett, advertising manager.

▸ *INDUSTRIAL COMBUSTION, INC.*—F. M. Jordan, sales manager.

▸ *POWERS REGULATOR CO.*—F. Maxson Clarke, personnel administrator; Richard G. Steckel, wage and salary administrator.

▸ *CHASE BRASS & COPPER CO.*—Paul R. Totten, works manager of Cleveland mill division.

▸ *INSTRUMENT SOCIETY OF AMERICA*—W. F. Minnick, Jr., director of public relations.

▸ *PITTSBURGH COKE & CHEMICAL CO.*—William T. McLaughlin, field sales manager for protective coatings division.

▸ *OHIO BRASS CO.*—Robert A. LeFevre, manager of marketing services; Joseph B. Polhemus, Jr., general advertising manager.

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PLASTIC

MOISTURE ELIMINATOR BLADES

for

Industrial Air-Conditioning

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LESS COSTLY TO MAINTAIN

Maintenance costs are negligible when you specify SOPLASCO Plastic Moisture Eliminator Blades. The superior surface of SOPLASCO Blades reduces to a minimum the possibility of algae and lint accumulation. Cleaning is accomplished without blade removal. Greater efficiency is guaranteed when you use SOPLASCO Plastic Moisture Eliminator Blades. Demand the best—insist on SOPLASCO on your next job or when the replacement of blades is necessary.

For further information write, wire, or phone SOPLASCO AIR PRODUCTS DEPT.

Southern Plastics Co.

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Columbia, S. C.

WHO'S WHAT

Continued

▸ *DRYOMATIC CORP.*—T. J. Hutchinson, sales engineering manager.

▸ *PRESSTITE DIV., AMERICAN-MARIETTA CO.*—A. H. Reando, manager of refrigeration sales.

▸ *A. Y. McDONALD MFG. CO.*—A. M. Meyers, product manager, pumps & water systems.

▸ *GLEN ALDEN CORP.*—Robert G. Axtell, director of marketing.

▸ *M. H. DETRICK CO.*—T. S. Clousing, general manager, insulation division.

▸ *WATER SERVICE LABORATORIES*—Robert W. Gaines, engineering sales staff.

▸ *CUTLER-HAMMER INC.*—E. S. Mathiesen, vice president in charge of manufacturing.

▸ *VOSS BELTING & SPECIALTY CO.*—Frank C. Seager, assistant to president.

▸ *UNITED WIRE & SUPPLY CORP.*—Robert J. Wilson, wire products sales manager.

▸ *ALUMINUM COMPANY OF AMERICA*—Kirk Usher, manager of tubular product sales.

▸ *ROSE POLYTECHNIC INSTITUTE*—Dr. Ralph A. Morgen, president.

▸ *WELBILT CORP.*—Peter Dalton, sales manager of air conditioning & heating division.

NEW dry-acid cleaners are concentrated, easier to handle, require less storage space. One 100-lb. drum, for example, occupies only 1.9 cubic ft. of storage space – is more than equivalent to a 192-lb. carboy of 18° Be' HCl.

OLD cleaning method required stocking bulky, returnable carboys of liquid acids. Special precautions are necessary in shipping and handling. And a 192-lb. carboy of 18° Be'hydrochloric acid occupies 5.6 cubic ft. of valuable storage space.

✓ Lower storage cost

Just one of the reasons why **Dry Acid Cleaners** based on **Du Pont Sulfamic Acid** are gaining wide favor for industrial equipment cleaning: ✓ Safer to handle ✓ Easy to use ✓ No hazardous fumes ✓ Powerful descaling action ✓ Less corrosive ✓ Lower handling and shipping costs.

CLEANERS BASED ON SULFAMIC ACID REMOVE SCALE AND DEPOSITS FROM:
Air-Conditioning Cooling Towers, Ice-Making Machines, Evaporating Condensers.

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Please send me:

☐ Free booklet about dry-acid cleaners based on Du Pont Sulfamic Acid

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about a Hot Water Problem?

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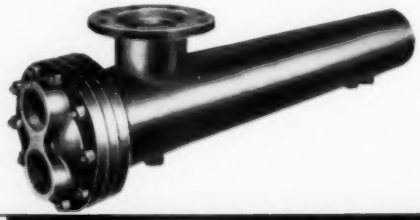
Instantaneous Converter !

Take any constant source of steam or boiler water . . . select the proper unit from General's full line of specification-rated converters . . . install this compact, high-efficiency, high-economy unit at any advantageous spot near existing steam lines or boiler . . . make a few simple piping connections . . . and presto, you have a steady supply of hot water!

Simple, isn't it? And you eliminate the need for space-consuming tanks . . . you minimize fuel consumption and heat waste . . . you cut maintenance and costly call-backs . . . and best of all, you win a satisfied user! Capacities range to 300 GPM. Let us send you complete technical data? Request Bulletin 61 describing the full line of GENERAL Instantaneous Water Heaters.



GENERAL FITTINGS COMPANY

EAST GREENWICH • RHODE ISLAND

WHO'S WHAT

Continued

▸ *NATIONAL INSULATION MFR. ASSN.*—president E. H. Luchs, vice president, MUNDET CORK CORP.; vice president R. A. McLaughlin, vice president, PITTSBURGH PLATE GLASS CO.; treasurer F. T. Christenson, secretary, REFRACTORY & INSULATION CORP.; J. M. Barnhart, executive secretary.

▸ *PENNSYLVANIA RANGE BOILER CO.*—Milton G. Peck, chairman of board.

▸ *KEASBEY & MATTISON CO.*—Albert W. Spedding, chief project engineer; Richard E. Lander, project engineer; Robert R. Porter, chairman of board.

▸ *MINNEAPOLIS - HONEYWELL REGULATOR CO.*—Frank P. Kelly, manager of manufacturing operations.

▸ *H. B. SMITH CO., INC.*—Lauren E. Seeley, president; Franklin A. Ferguson, honorary vice chairman of board.

▸ *PHILIP CAREY MFG. CO.*—Paul D. Japp, director of sales; A. J. Bainum, industrial products division vice president; C. J. Bainum, western division vice president; J. W. Bartlett, midwest division vice president; W. E. Hess, central division vice president; Gordon Ellis, southern division vice president; John W. Humphrey, division vice president.

▸ *ALLIS-CHALMERS MFG. CO.*—Russell A. Hedden, works manager of manufacturing, industries group; Boyd S. Oberlink and J. L. Singleton, senior vice presidents; Roy M. Casper, general manager, atomic energy division; L. W. Davis, general manager, farm equipment division.

WHO'S WHAT

Continued

▸ *MILWAUKEE GAS LIGHT CO.*—Harold P. Mueller, Sr., elected to board of directors.

▸ *AMERICAN BOILER MFR. ASSN.*—trustee and member of executive committee, Fred W. Hainer, executive vice president, *CLEAVER-BROOKS CO.* and President of *SPRINGFIELD BOILER CO.*

▸ *SLANT/FIN RADIATOR CORP.*—M. Morton Pizer, head of apartment house division.

▸ *DETROIT STOKER CO.*—M. J. Churchill, manager of stoker sales.

▸ *WESTINGHOUSE ELECTRIC CORP.*—H. W. Rainey, Jr., general sales manager of Sturtevant division; Marion J. Kolasa, Detroit district manager for Sturtevant division.

▸ *JOSEPH T. RYERSON & SON, INC.*—Loren B. Clay, sales manager, Houston, Texas; James W. Provan, manager of general order and merchandise inventory dept.

▸ *BLACK & DECKER MFG. CO.*—Jay T. Redmon, Cincinnati district manager; R. G. Horner, vice president, marketing; Paul J. Gagliano, Minneapolis district manager.

▸ *A. O. SMITH CORP.*—R. E. Axthelm, supervisor of application engineering.

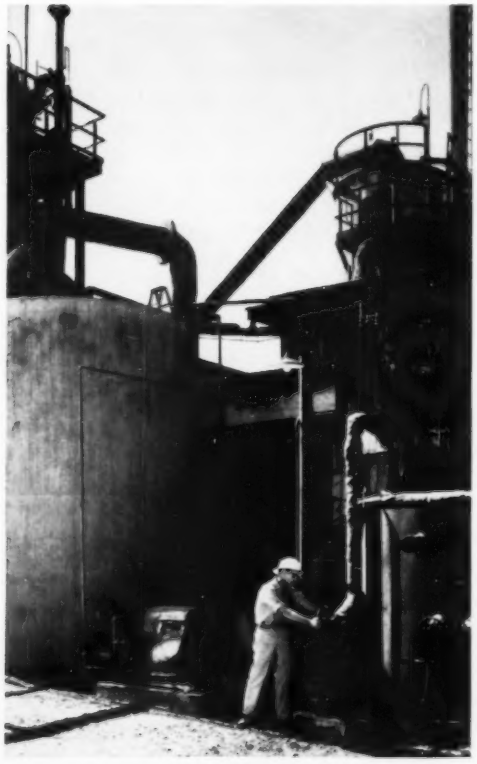
IN THE TERRITORIES . . .

(Recent sales appointments)

▸ *TRANE CO.*—E. Milton Bevington, manager of Atlanta sales office; Robert W. DeBenham, sales engineer in New York office.

▸ *GENERAL ELECTRIC CORP.*—Steveco, Atlanta, Ga. distributor: Mrs. B. B. Stevens, president; Fred R. Stevens, executive vice president.

▸ *PENN CONTROLS, INC.*—Elmer A. Rave, heading Chicago district sales office; Birmingham district sales office moved to P. O. Box 9191, Chattanooga 11, Tenn.



Tanks supply feedwater to the boilers which produce steam for the manufacture of sulphuric acid. Water clarifier tank is on right, treated water storage tank on left.

Quick case history—reading time 47 seconds

How Hagan Coagulant Aid ended carryover problems at Pennsalt Acid Plant

No extra feeding equipment needed

Pennsalt Chemicals Corporation's plant at Calvert City, Ky., had a serious floc carryover problem when clarifying with alum and activated silica. Filters clogged rapidly and carryover of floc to the boiler was highly undesirable.

Pennsalt engineers investigated the effect of various polyelectrolytes and recommended changing to alum and Hagan Coagulant Aid No. 7. After more than 18 months of this treatment, the plant reports these benefits:

- **elimination of the carryover problem**
- **reduction in overall chemical cost**

And, a great benefit from Pennsalt's point of view, the switch to Hagan Coagulant Aid was accomplished without the necessity of adding feeding equipment.

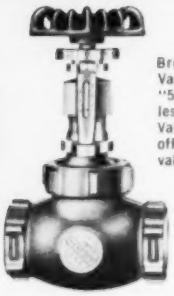
Hagan has a number of Coagulant Aids, all of which are easy to handle, and may be fed either dry or in solution. Many are approved for use in clarification of drinking water. To find out which of these Aids is best suited to solve your water clarification problem, write for Bulletin 410-12-2 describing Hagan Coagulant Aids.

CALGON COMPANY
DIVISION OF HAGAN CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PA.
In Canada: Hagan Corporation (Canada) Limited, Toronto

Heating and Air Conditioning

FLOW CONTROL

HANCOCK VALVES DO THE JOB *ECONOMICALLY*



Bronze "Flocontrol" Valves. ¼" thru 2". "500 Brinnell" stainless steel V-port disc. Variable orifice, shut-off and index in one valve.

Reliable control of flow contributes substantially to complete owner satisfaction with every heating, piping, and air conditioning system you install.

Whether the application demands pin-point control of flow or full flow, Hancock Valve performance proves there is no substitute for the economy of quality. Highest operational perfection is combined with lowest maintenance. Whatever the piped medium – fuel oil, gas, water, or steam – the quality of Hancock Valves helps assure uninterrupted service. Typical advantages of Hancock Bronze and Steel Valves are:

RUGGEDNESS that continues to ward off the deteriorating effects of wire drawing, galling, steam cutting, erosion and corrosion long after ordinary valves fail.

MAINTENANCE ECONOMY because carefully selected materials are precision-formed into functional parts of long-lasting efficiency. Servicing can be done in the line. Standardization of components means inventory economy.

Learn all the job-proved reasons why Hancock Valves are today's best buy in terms of your standard of reliability. Globe, Angle, Gate, and "Flocontrol" types available with application characteristics suited to your heating, piping, and air conditioning requirements. *Write for Catalog 200A.*

Steel "Flocontrol" Valves. ¼" thru 2". V-port disc compels proportional flow throughout the lift of the stem.

600# Steel Gate Valves. ¼" thru 2". Forged steel body. Maximum use of stainless steel.

600# Steel Valves. Globe and Angle. ¼" thru 2". Forged steel body. "500 Brinnell" stainless steel disc.

Bronze Valves. Globe and Angle. ¼" thru 2". "500 Brinnell" stainless steel seat and disc. 125% to 230% stronger diaphragm.

MAXWELL MANNING MOORE TRADE MARK

HANCOCK VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

WHO'S WHAT

Continued

▸ *CHEMETRON CORP.*—Edmund W. Dugan to head new company office at Moreschi Building, 905 16th St., N. W., Washington, D. C.; Star Corp., distributor in Freeport, Texas; Longhorn Supply Co., distributor in Houston.

▸ *KEASBEY & MATTISON*—Harlan J. Corson, Cleveland district manager.

▸ *GELMAN INSTRUMENT CO.*—C. W. Reed Co., representative in 11 western states.

▸ *RECOLD CORP.*—Reese Associates, representative in Minnesota, eastern half of Dakotas, northwest Wisconsin.

▸ *TEXAS INSTRUMENTS, INC.*—Herbert R. Greene, northeastern regional manager; Clifford J. Grube, eastern regional manager; J. Alfred Bagnall, central regional manager; O. V. Miller, midwestern regional manager; James R. Rowland, western regional manager.

▸ *BROWN FINTUBE CO.*—R. T. Ferguson, representative in southern California.

▸ *ALL-STATES WELDING ALLOYS CO.*—new distributors: M. Blazer & Co., Passaic, N. J.; Vaeth Electric Co., Utica, N. Y.; Smolka Co., New York City; Amick & Miller, Charleston, West Va.; Abe Gruber & Co., Elizabeth, N. J.; Air Conditioning and Refrigeration Co., Anchorage, Alaska.

▸ *YOUNG RADIATOR CO.*—J. P. Elliott, manufacturer's representative for Buffalo, N. Y. area.

▸ *A. M. BYERS CO.*—Douglas F. Williams, field service engineer for southern New Jersey and eastern Pennsylvania including Harrisburg.

▸ *DUNHAM-BUSH, INC.*—Robert Freier, assistant district sales manager for Detroit area; Thomas Ottolini, application engineer in St. Louis district.

▸ *BAILEY METER CO.*—B. E. Gallagher, resident engineer in Indianapolis, Ind., subdivision of Chicago district.

▸ *CHASE & SONS, INC.*—Douglas E. Rood, manager Corrprev Div. southwest area.

WHO'S WHAT

Continued

▸ *BABCOCK & WILCOX*—J. J. Koss, Milwaukee district sales representative.

▸ *COOLERATOR DIV., McGRAW-EDISON CO.*—Peerless Pacific Co., distributor in Oregon and Washington.

▸ *CUTLER-HAMMER, INC.*—E. C. Bolton, midwestern regional sales manager; J. H. Sauer, Cincinnati district manager; R. A. Pancoast, Indianapolis district sales manager.

▸ *AIR CONDITIONING SUPPLY CO.*—new branch office at 3752 Rosecranz Blvd., San Diego, Calif.

▸ *COCHRANE CORP.*—Howard Bass, new sales engineer with Henry P. Thompson Co., sales representative.

▸ *STANDARD TUBE CO.*—Fred W. Bush, sales representative in southwestern U. S.

▸ *CHAMPION BLOWER & FORGE CO.*—Joseph H. Hucker, manufacturer's representative in eastern Pennsylvania and southern New Jersey.

▸ *H. D. CONKEY & CO., FIELD CONTROL DIV.*—Edward Lepowsky, sales representative for greater New York, Boroughs and Long Island areas.

▸ *J. E. LONERGAN CO.*—Industrial Process Equipment Co., representative in St. Louis, Mo.

▸ *MOTOR WHEEL CORP.*—Ivan J. Laucik, Chicago representative for Duo-Therm heating equipment.

▸ *D. J. MURRAY MFG. CO.*—A. H. Belouske & Assoc., distributors in 12 counties of Illinois which include Rock Island and 17 counties in Iowa which include Des Moines and Dubuque.

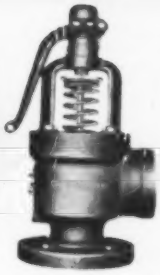
▸ *RITTLING CORP.*—Irving M. Day Co., sales representative in Washington, D. C. area.

▸ *A. Y. McDONALD MFG. CO.*—William A. Headlee, manager of Kansas City, Mo. branch.

▸ *WARREN PUMPS, INC.*—Stolley & Orlebeke, Chicago sales representative; Carlson-Rutledge Co., Cleveland sales representative. ∓

OVERPRESSURE

CONSOLIDATED SAFETY VALVES GIVE POSITIVE PROTECTION



Type 1511 Safety Valve. Cast iron body. Maximum capacity for saturated steam. Sizes: 1½" through 6". Pressures to 250 psi. Temperatures to 450°F.

Make certain steam, air and gas pressures are held within safe limits on your heating, piping, and air conditioning projects. Consolidated Safety Valves automatically relieve overpressures in everything from package-type boilers and large steam generators to air tanks and other unfired pressure vessels. A 2100-pound design boiler is used to test and set these valves—to guarantee capacities and assure the best protection. Typical plus values of Consolidated Safety Valves are exemplified in the Type 1511:

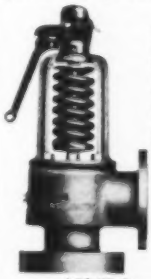
Compactness saves space and headroom; permits the use of smaller, more economical discharge piping.

Lower Cost per pound of steam discharged because maximum capacity is designed into minimum flange size. Fewer or smaller safety valves can be used on a boiler.

Better Alignment through double-guided adjusting ring and disc guide assures easier, more uniform blowdown adjustment and control, and finer operation.

Positive Tightness is created because the seat is machine-lapped to optical flatness.

On large or small installations, spring-loaded Consolidated Safety Valves give positive protection to personnel and facilities. Whatever the working pressures and temperatures of your heating, piping and air conditioning projects, choose Consolidated. Precision-made with few working parts, they are tough, long-life safety valves that rarely require maintenance. *Write for Catalog 700A.*



Type 1415 Safety Valve. Cast steel body. High capacity for saturated and superheated steam. Sizes: ½" through 6". Pressures to 900 psi. Temperatures to 900°F.

Type 1551 Safety Valve. Bronze body. For steam, air, gas. Sizes: ⅜" through 3". Pressures to 300 psi. Temperatures to 450°F.

ASME Standard • ASME Tested • National Board Certified

CONSOLIDATED SAFETY VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

WE HEAR THAT . . .

▸ *CRANE CO.* has purchased *CHAPMAN VALVE MFG. CO.* The new subsidiary will retain its present name and management.

▸ *JAMESBURY CORP.* announced a new expansion to its total plant area which will add 70 percent to present floor space.

▸ *NATIONAL-U. S. RADIATOR CORP.* has purchased *MAGNETIC POWDERS, INC.*

▸ *RAMSET FASTENING SYSTEM* has moved its headquarters from Cleveland to New Haven, Conn.

▸ *AMERICAN AIR FILTER CO., INC.* has established the Robert W. Nelson memorial award which will be presented to one of its field sales engineers.

▸ *ARMCO STEEL CORP.* announced plans to double the size of its Middletown, Ohio research center. The $3.5 million expansion program will increase present facilities by 69,000 sq ft. The project will be completed in early 1961.

▸ *F. J. STOKES CORP.* has broken ground for a 50,000 sq ft addition to its plant at 5500 Tabor Road in Philadelphia.

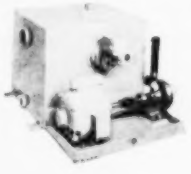
▸ *ALLIS-CHALMERS MFG. CO.* has announced plans to acquire *VALLEY IRON WORKS CO.* of Appleton, Wis.

▸ *WATER SERVICE LABORATORIES, INC.* has leased space at 1516 P St., Washington, D. C. to house sales and general headquarters of that branch.

▸ *CENTRAL FOUNDRY CO.* has moved from its Newark, N. J. quarters to 932 Broadway, New York City.

▸ *EMBASSY STEEL PRODUCTS, INC.* has announced opening of a new warehouse in Anchorage, Alaska.

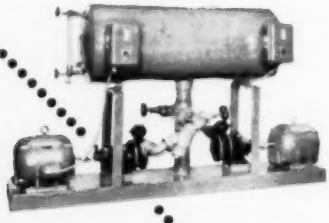
▸ The *PEERLESS ELECTRIC CO.* has become the *PEERLESS ELECTRIC DIV.—H. K. PORTER CO., INC.* Porter plans expansion of the newly acquired company's electric equipment lines.



EAGAN EAGLE —For steam heating loads up to 8000 sq. ft. at 20 p.s.i. Does not require pit even though return lines are no more than one foot above the floor.

EAGAN HOT POT —Vertical submerged type pump with cast iron receiver. Motor and pump above receiver safe from flooding. Single and duplex construction. Models for loads up to 15,000 sq. ft. at 20 p.s.i.

TYPE ECIV —Vertical pump and receiver for installations where return lines are below floor levels. Single or duplex units. Models up to 10,000 sq. ft. capacity at 60 p.s.i.



TYPE EC —Straight line arrangement requiring less floor space than necessary for competitive makes. Both pumps accessible for maintenance purposes. Single and duplex models designed for 2000 to 100,000 sq. ft. discharging against pressures of from 10 to 200 p.s.i.

EAGAN . . .

the complete line of Condensate Return Pumps

Eagan offers a full line of Condensate Return Pumps, and also manufactures Fuel Oil Pump and Heater Sets, Proportioning Pumps, Turbine Pumps and Centrifugal Pumps.

WALTER H. EAGAN CO., INC.

Pump Specialists Since 1920

2336 Fairmount Ave., Dept. HPAC, Phila. 30, Pa.

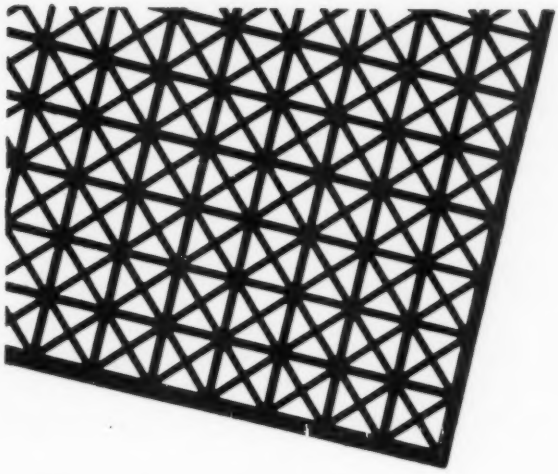
Gentlemen:
Send me complete information on the EAGAN Line of Condensate Pumps.

COMPANY .....

NAME .....

ADDRESS .....

CITY ..... ZONE .. STATE .....



THEY'RE ELEGANT ...THEY'RE ECONOMICAL

Hendrick Architectural Grilles

When an architect draws up specifications for a new building or a modernization proposal he must adhere to two basic principles: FIRST, he must use his head in keeping costs down. SECOND, he must recommend functional materials and components that appeal to his client's decorative motif and sense of beauty. That's why more and more architects specify Hendrick Grilles. Available in hundreds of attractive designs, Hendrick Grilles cost less to buy . . . cost less to install and cost less to maintain! And they provide more-than-ample area for free passage of air . . . always lie flat . . . don't bend or warp. For more information write to Hendrick, today.

HENDRICK

MANUFACTURING COMPANY

48 DUNDAFF STREET — CARBONDALE, PA.

Perforated Metal • Perforated Metal Screens • Wedge-Slot Screens • Hendrick Wedge Wire Screens • Architectural Grilles Mitco Open Steel Flooring — Shur-Site Treads • Armorgrids Hydro Dehazers • Petrochemical Column Internals

#625

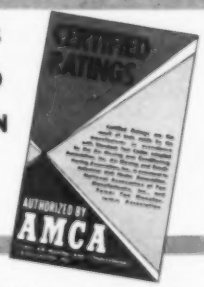
Aladdin

AIR HANDLING EQUIPMENT

Type "S" *Centrifugal*

ROOF VENTILATORS

- CERTIFIED RATINGS
- ALUMINUM HOUSED
- ATTRACTIVE DESIGN
- WEATHERPROOF
- QUIET OPERATION



ALADDIN Type "S" Roof Ventilators feature an attractive Spun Aluminum Housing of low contour. Designed especially for those installations which require a small powered exhaust unit. The Type "S" Roof Ventilator is ideally suited for schools, hospitals and similar type buildings.

Seldom requiring maintenance, these units are furnished with unusually quiet, fan cooled motors with outstanding lubricating systems, assuring long, continuous service under severe conditions of dust and dirt.

Write for complete data

ALADDIN HEATING CORPORATION

1111 WEST AVENUE 137 • SAN LEANDRO, CALIFORNIA

WE HEAR THAT

Continued

▸ Effective October 1, 1959. *BRUNER CORP.* became a wholly-owned subsidiary of *HAGAN CHEMICALS & CONTROLS, INC.*

▸ The National Safety Council presented an award of merit to the *W-K-M DIVISION OF ACF INDUSTRIES, INC.* for its excellent safety record.

▸ *WARREN WEBSTER & CO., INC.* has consolidated sales offices at its home office and factory at 17th and Federal Streets in Camden, N. J.

▸ *CLARAGE FAN CO.* has opened a new 320,000 sq ft plant in Kalamazoo, Mich.

▸ *STODDARD INDUSTRIES* has moved its offices from Chicago to 3383 E. Layton Ave., Cudahy, Wis.

▸ The *NATIONAL FUELOIL COUNCIL* has been joined by *STANDARD OIL CO. (INDIANA), SUN OIL CO.*, and *TIDEWATER OIL CO.*

▸ The Philadelphia Branch of *RECOLD CORP.* has moved to 628 Davisville Road, Willow Grove, Pa.

▸ *HENRY VALVE CO.* has increased its existing facilities by 40 percent through purchase of adjacent land and a building on it.

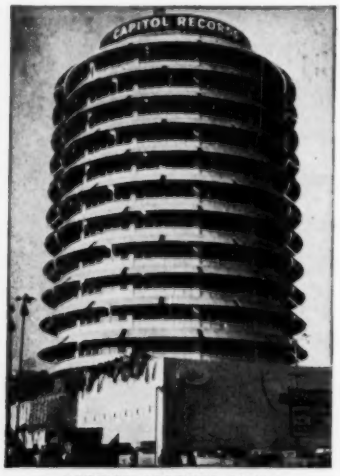
▸ *CRANE CO.* has completed shipment of 7 tons of commercially pure titanium pipe and valves to Moa Bay Mining Co. in Cuba.

▸ *WESTINGHOUSE ELECTRIC CORP.* has built a new test facility for canned motor pumps in its atomic equipment department in Cheswick, Pa.

▸ The *BETTER HEATING-COOLING COUNCIL* has launched a new program to promote hydronic heating and cooling systems in commercial, institutional and industrial markets.

▸ New and larger quarters have been established by *EUTECTIC WELDING ALLOYS—CENTRAL DIVISION, INC.* at 4353 S. Kedzie Ave., Chicago.

▸ *CHICAGO PUMP CO.* is celebrating its 50th anniversary this year. ≠



CAPITOL RECORDS BLDG.
LOS ANGELES, CAL.

WELTON, BECKET & ASSOCIATES, ARCHITECTS-ENGINEERS, STATE PLUMBING & HEATING CO., MECHANICAL CONTRACTOR

Capitalize on

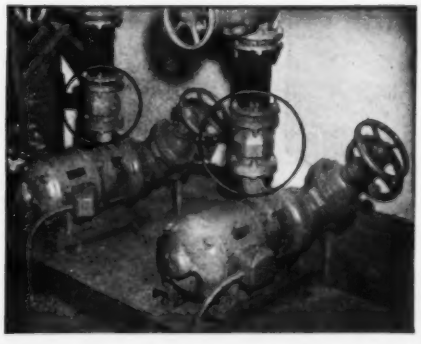
MILLER Streamflow CHECK VALVES

Completely Silences your piping system! CENTER-GUIDED, SHOCK PROOF, NOISELESS, ELIMINATES WATER HAMMER. FULL RADIAL FLOW. FACTORY MUTUAL LABORATORIES APPROVED.

SIZES 1" THROUGH 24".

FLANGED, ASA DRILLING, IBBM, CAST STEEL, ALL ALLOYS. FOR ALL FLUIDS AND GASES.

CERTIFIED MINIMUM PRESSURE DROP CURVE AVAILABLE



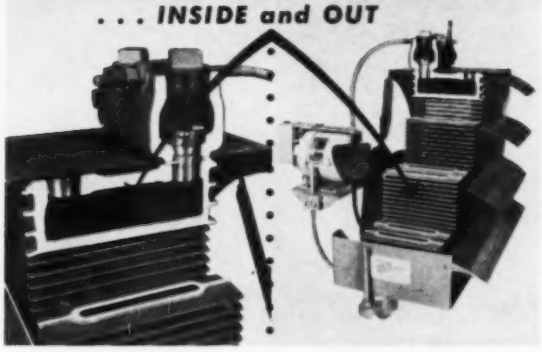
Write for literature • Agents in Principal Cities

MILLER VALVE CO., INC.

Pittsburgh 30, Pa. Plant—1620 Pennsylvania Ave.

it's the material that makes the difference . . .

. . . INSIDE and OUT



CORROSION causes heating equipment failures!

BUT NOT WHEN YOU USE

GRID

cast iron construction

- **UNIT HEATERS**
- **BLAST HEATERS**
- **RADIATORS**

Designed for operation on steam pressure up to 250 PSI 450° temperature

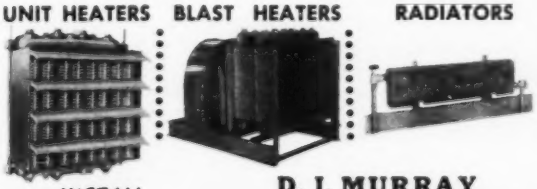
CORROSION internally, caused by electrolytic action as in copper tubes, can't happen in GRID's cast iron steam chambers and headers. Nor can acid condensate corrode the bottom connections. Cast iron, internally, resists corrosion.

CORROSION externally, caused by acid fumes cannot destroy GRID's cast iron finned heating surface. Widely spaced fins cast integral with the steam chamber will not corrode externally.

ORDINARY HEATING SURFACES FAIL BECAUSE OF CORROSION INSIDE AND OUT! AVOID THESE COSTLY HEATING FAILURES!

Send for Catalog 956 . . . The complete story on Grid Unit Heaters, Blast Heaters and Radiators.

UNIT HEATERS **BLAST HEATERS** **RADIATORS**



INSTALL

GRID

CAST IRON

D. J. MURRAY MANUFACTURING CO.

Manufacturers Since 1883

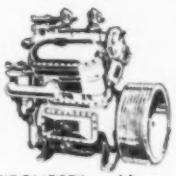
WAUSAU, WISCONSIN

OFFICES IN PRINCIPAL CITIES

Yes!

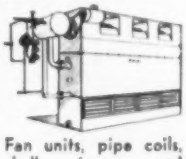
We have all the components

FRICK DISTRIBUTORS *and* FRICK USERS can select from the industry's greatest line of compressors, condensers, coolers, coils and controls.



"ECLIPSE" and heavy-duty compressors: sizes up to 1,000 tons refrigeration.

They also get the advantages of many exclusive Frick engineering developments, a few of which are illustrated. When you or your clients need air conditioning, refrigeration, ice making or quick freezing equipment, in any commercial or industrial sizes, check first with Frick.



Fan units, pipe coils, shell, zig-zag and other types of coolers for air, water, brine, etc.

DEPENDABLE REFRIGERATION SINCE 1882

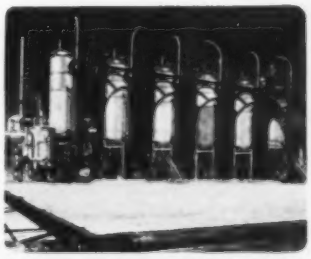
FRICK CO.

WAYNESBORO, PENNA., U. S. A.

Valves, Fittings and Controls, for manual or full-automatic operation.

Prestfin coils have 9 to 13 times the surface of bare pipe, assure high humidity in storage. Also remove superheat from hot gases.

Evaporative and shell-type condensers.



Synthetic rubber and other chemical plants find Frick patented systems the answer to various needs.

Shell-Ice is frozen automatically on stainless-steel tubes, is hard and clear. Preferred in fountains, restaurants, dairies, poultry plants, fisheries, by shippers, etc.

MEETINGS & CONVENTIONS

1959

NOV. 12-13—*Air Conditioning Institute.* University of Wisconsin, Madison, Wis. Information: R. L. Loetscher, Engineering Institute, University of Wisconsin, Madison, Wis.

NOV. 12-13—*2nd Annual Texas Conference on the Utilization of Atomic Energy.* A & M College of Texas. Information: A & M College of Texas, College Station, Texas.

NOV. 16-20—*National Association of Corrosion Engineers,* annual general Florida conference and corrosion short course. Key Biscayne Hotel, Miami. Information: National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.

NOV. 30-*DEC.* 11—*Air Pollution Course.* Institute of Industrial Medicine, New York University with the College of Engineering. Information: New York University—Bellvue Medical Center, Institute of Industrial Medicine, 550 First Ave., New York 16.

DEC. 1-4—*National Warm Air Heating and Air Conditioning Association,* committee meetings and annual convention. Chase Hotel, St. Louis, Mo. Information: National Warm Air Heating and Air Conditioning Association, 640 Engineers Bldg., Cleveland 14.

DEC. 7-11—*4th Biennial Short Course in Corrosion Control.* University of Illinois, Urbana, Ill. Information: Supervisor of Engineering Extension, Illini Hall, Champaign, Ill.

DEC. 7-11—*Plumbing-Heating-Cooling Information Bureau* sales training course for instructors. Del Prado Hotel, Chicago. Information: Plumbing-Heating-Cooling Bureau, 35 E. Wacker Drive, Chicago 1.

1960

JAN. 22-23—*National Association of Corrosion Engineers,* 5th annual corrosion control short course. University of Houston. Information: Course Chairman, M. A. Riodan, Rio Engineering Co., P. O. Box 6036, Houston 6.

As Simple as ABC

A COMPLETE UNIT

LOW RETURN
LOW SPEED
LOW WATER LINE

CAST IRON RECEIVER – for long life!

A RETURN

DISCHARGE B

C ELECTRICAL

A — One return line connection

B — One discharge line connection

C — One electrical connection

The TVC Condensate Pump is a low speed (1750 R.P.M.) pump for long life and trouble free service.

The unit is completely factory assembled for a simple A-B-C installation.

The low return connection and compactness of the unit provides for simple installation in all locations – particularly where space is limited.

DIMENSIONS

Single Unit—Cap. to 6000 sq. ft. E.D.R. 21" Dia. receiver; hgt. of return above floor only 6⅞".

Duplex Unit—Cap. to 10,000 sq. ft. E.D.R. 25½" Dia. receiver; hgt. of return above floor only 7⅜".

Duplex Unit—Cap. to 15,000 sq. ft. E.D.R. 25½" Dia. receiver; hgt. of return above floor only 10½".

Send for Bulletin TVC-300

CAPACITIES FROM 750 TO 15,000 SQ. FT. E.D.R. — PRESSURES TO 40 P.S.I.

weil PUMP COMPANY

Available from Jobber's Stocks!

1514 N. Fremont St., Chicago 22

"...flexible modular construction; two bearings, lifetime lubricated; all panels removable; center hub rotors!..."*

* "...and packed with many more facts in a just-printed, 48-page catalogue about what D-H *now* offers you in its popular 30-model central station air conditioning units (horizontal and vertical). Handy time-saver fan performance curves included, too!" Contact direct for Engineering Manual No. CSHV 312, and name of Manufacturer's Agent nearest you. *Send for yours.*

d-h SINCE 1918

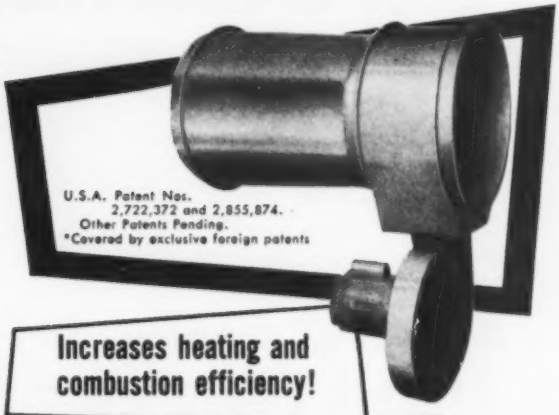
MEMBER OF AMCA

drayer-hanson

DIVISION NATIONAL U.S. RADIATOR CORP.

3301 MEDFORD ST., LOS ANGELES 63, CALIF.
CABLE: CLICONI, LOS ANGELES

Quickdraft...THE WORLD'S SAFEST POWER DRAFT UNIT FOR INDUSTRIAL, RESIDENTIAL AND INSTITUTIONAL EXHAUSTING



U.S.A. Patent Nos. 2,722,372 and 2,855,874. Other Patents Pending. *Covered by exclusive foreign patents

Increases heating and combustion efficiency!

Provides air power for bulk materials handling!

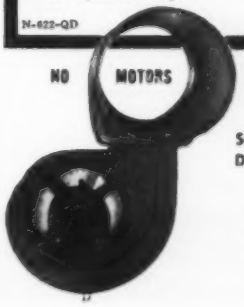
Exhausts corrosive gases and abrasives!

Quickdraft provides industry, commerce, institutions and homebuilders *power draft* engineered for economical and efficient combustion regardless of building or atmospheric conditions. Models suitable for every heating or incinerator application . . . eliminate pulsating or chattering, puffing, smoking and sooting. Reduce building costs, no tall, unsightly stacks required. Quickdraft also provides industry with ¼ inch to 60 inches W.G. static pressure for exhausting corrosive gases, abrasives and paint spray. Heavy-duty, high-pressure models, 6 inches to 30 inches diameter, are available for moving bulk materials or anything that can be moved by air. Because there are no motors, fans or bearings in exhaust line, only Quickdraft avoids costly clogging, corrosion of moving parts or fan failure.

IMPORTANT NOTICE

For withstanding corrosive gases, all Quickdraft units are available in standard acid resisting vitreous enamel, No. 316 Stainless Steel, rigid plastics (P.V.C.) and with plastic and Fiberglas coatings.

N-622-QD



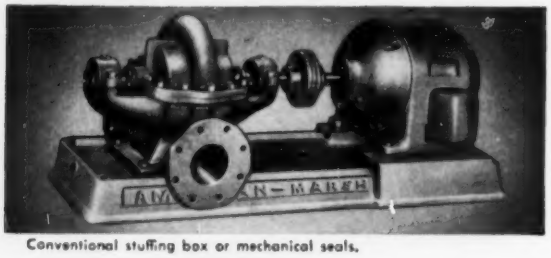
NO MOTORS FANS OR BEARINGS IN EXHAUST LINE

Send for QUICKDRAFT ENGINEERING DATA on your application . . . now.

Quickdraft CORPORATION

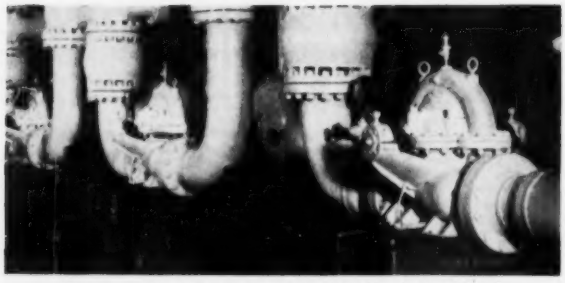
P.O. Box 87-K, Canton 1, Ohio

Install American-Marsh
PUMPS LIKE THIS



Conventional stuffing box or mechanical seals.

on vital heavy-duty
JOBS LIKE THIS
FOR PERMANENT SATISFACTION!



Above — Three bronze-fitted American-Marsh Centrifugals, with direct drive 150 HP motors, each circulate up to 2,000 GPM of chilled water in air conditioning system.

WHEN YOU SELECT or recommend an American-Marsh Pump, you know it's backed by 80 years' experience in building pumps — and pumps only!

WHEN YOU INSTALL it, you know it was individually factory tested to meet all specifications before shipment. (*Every* A-M pump is fully tested!)

IF YOU'D LIKE suggestions on the best type and size for *your* job, call your American-Marsh representative. He'll help make sure *your* pump gives permanent satisfaction!

WRITE FOR BULLETIN 350 for details of Model HLM above — or describe your application.

AMERICAN-MARSH PUMPS

BATTLE CREEK MICHIGAN

Pumps and Pumps only Since 1873

CENTRIFUGAL, TURBINE, STEAM AND POWER PUMPS FOR TESTING, PROCESSING, BOILER FEED, FIRE PROTECTION, ETC.

MEETINGS & CONVENTIONS

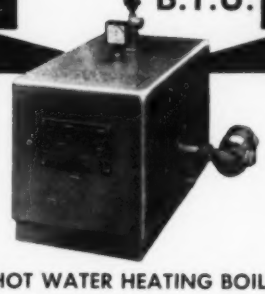
Continued

FEB. 1-4—*2nd Southwest Heating and Air Conditioning Exposition.* Dallas. Under auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, in conjunction with the newly merged society's semi-annual meeting also in Dallas. Meetings to be held in the Baker and Adolphus Hotels; exposition to be held in Memorial Auditorium. Information: International Exposition Co., 480 Lexington Ave., New York 17. ASHRAE headquarters: 62 Worth St., New York 13.

FEB. 2-4—*Society of the Plastics Industry, Inc.*, 15th SPI Reinforced Plastics Division Conference. Edgewater Beach Hotel, Chicago. Information: Society of the Plastics Industry, Inc., 250 Park Ave., New York 17.

FEB. 1-5—*Instrument Society of America*, instrument-automation conference and exhibit. Houston Coliseum. Information: William H. Kushnick, Executive Director, Instrument Society of America, 313 6th Ave., Pittsburgh 22.

ELECTRIC HOT WATER HEAT TO 2,000,000 B.T.U.



- 40,948 B.T.U. to 2,000,000 B.T.U. Output.
- All units meet the requirements of the ASME Boiler and Pressure Vessel Code.

PRECISION *Electric* HOT WATER HEATING BOILER

- **Complete unit ready for installation** with circulating hot water system and water chiller for year-round air-conditioning.
- **Conversion easily accomplished** where other type fuels now used. Suited for homes, churches, apartments, hotels, motels, hospitals, commercial buildings, swimming pools, snow melting and domestic hot water. Temperature Range 60 to 250 degrees.
- **Every unit tested and inspected.**

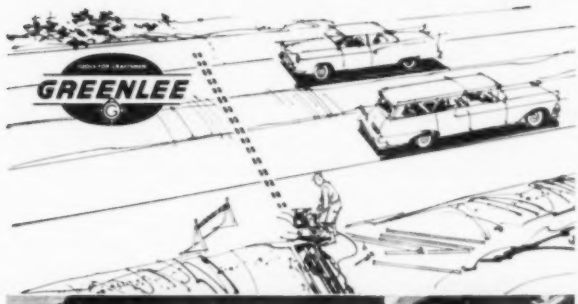
Write for color brochure and prices.

PRECISION parts corporation

400-HPAC North 1st Street
Nashville 7, Tennessee

No ducts! No noise! No chimney! No odors! No flame!

EASY, Low-Cost Way to Run Pipe Under Streets, Walks, Floors



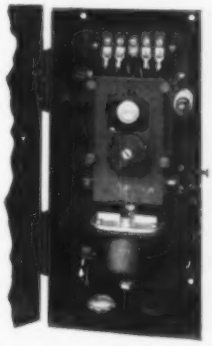
Greenlee Hydraulic Pipe Pusher
Hand- or Power-Operated

Traffic proceeds as usual when your piping crosses under streets or sidewalks this simple, timesaving way. Model No. 790 shown pushes $^{3}/_{4}$" - 4" pipe about two feet per minute with power pump. A small ditch in the parkway accommodates the pusher — streets and walks remain undisturbed. Costly tearing up, tunneling, filling, repaving are eliminated . . . total job time and cost are cut to a fraction. The same efficiencies and savings apply on under-floor installations or on pipe-pulling jobs. That's why the GREENLEE Pipe Pusher often pays for itself the first few times used. See your supplier for a demonstration or write for descriptive literature.

GREENLEE LINE OF TIMESAVING TOOLS FOR PIPE FITTERS AND PLUMBERS ALSO INCLUDES PIPE BENDERS, PIPE BITS, POWER BITS

GREENLEE TOOL CO. GREENLEE
1770 Columbia Ave., Rockford, Illinois

MAINTAINS CONSTANT TEMPERATURE



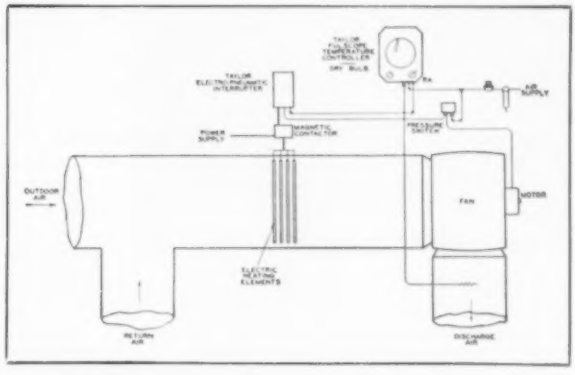
The Taylor Electro-Pneumatic Interrupter acts as a valve to proportion the flow of electrical energy on applications using electricity for heating.

This device makes it possible to maintain a constant temperature. And it eliminates the time lag often experienced on drying, space heating, and platen press applications by proportioning the electrical flow to the heaters.

It operates in conjunction with a FULSCOPE* Temperature Controller which sends an output pressure to the Interrupter's low pressure bellows unit. A plunger, on this unit, engages a micro-switch when there is a demand for heat. As the demand diminishes, the output pressure from the controller diminishes and the plunger of the bellows is fixed in such a position that the current "on" and "off" period is just sufficient to maintain a constant temperature.

Ask your Taylor Field Engineer or write for full details. Taylor Instrument Companies, Rochester, N.Y., and Toronto, Ontario.

*Reg. U.S. Pat. Off.



Taylor Instruments
MEAN ACCURACY FIRST

J-E TYPE 701
3-WAY SOLENOID VALVE

for flow control of hot or chilled water with fan-coil units

This New addition to the J-E Line provides–

- **Economical temperature control.**
- **Separable solder flange for easy installation.**
- **One size for ½ to 10 gpm for simple selection**

Write for information bulletin today.

Controls Division
JACKES-EVANS MANUFACTURING CO.
4427 Geraldine Ave., St. Louis 15, Mo.

MEETINGS & CONVENTIONS

Continued

MARCH 11-18—*National Association of Corrosion Engineers*, annual conference and corrosion show. Dallas Memorial Auditorium. Information National Association of Corrosion Engineers, 1061 M & M Bldg., Houston 2.

MARCH 29-31—*22nd Annual American Power Conference*. Hotel Sherman, Chicago. Information: Conference Director, R. A. Budenholzer, Mechanical Engineering Dept., Illinois Institute of Technology, 3300 Federal St., Chicago 16.

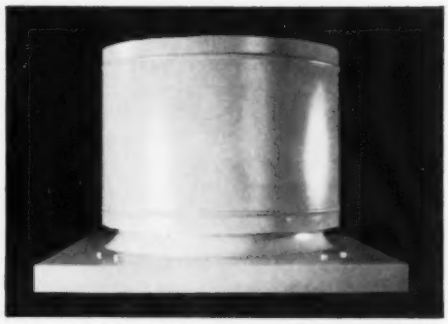
APRIL 4-7—*Oil Heat Institute of America*, convention and exposition. convention: Park-Sheraton Hotel, New York, exposition: Coliseum, New York. Information: Oil Institute of America, Inc., 500 5th Ave., New York 36.

APRIL 25-29—*American Welding Society*, annual meeting and exposition. Los Angeles. Information: American Welding Society, 33 W. 39th St., New York 18, N.Y.

NEW AXIAL ROOF VENTILATORS BY WESTERN

The Westernaire® Low Silhouette Hooded Exhaust Ventilator

The Westernaire® Low Silhouette Vertical Exhaust Ventilator



Above: A high efficiency power unit in a low, weather-proof housing. For both commercial and industrial use. 360 degree near horizontal discharge. Aerodynamically correct spun housing. Heavy guage steel, aluminum or non-corrosive Fiberglas* construction.

Low silhouette high efficiency power roof ventilators for vertical or horizontal air discharge provide motor mounting below the venturi to achieve styling compatible with modern architecture plus a smooth airstream discharge pattern.

Above: High capacity power unit specifically designed for industrial usage. Fumes, smoke, dust-laden and foul air projected high above roof to prevent re-entry into building. "Blow-open" dampers rest on neoprene seal. Completely weatherproof.

Other type ventilators include: Rotary, Stationary, Directional, Continuous Ridge, Unit, Power models.

WESTERN ENGINEERING & MFG. CO.

P. O. BOX 66455, LOS ANGELES 66, CALIFORNIA

Write for catalog and name of nearest representative

*Since 1921

*TM- Owens Corning Fiberglas Corp.

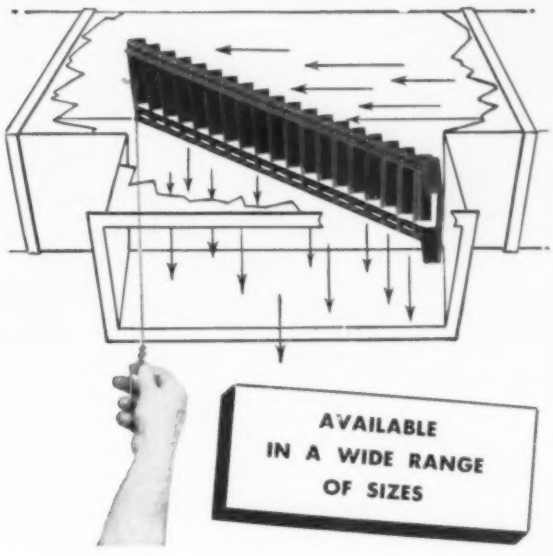
NOW . . . *Divert Air Where You Want It!*

A-J

AIR "EXTRACTOR"

This new A-J Air Extractor gives you maximum control of any forced air system. It's not a "damper type" control to meter available air flow through a grille, but a "scoop" that diverts air from the main duct to branch ducts or grilles and increases output over normal flow where needed.

The curved steel blades of the A-J Extractor are adjustable and act in unison to provide a controlled and uniform flow of air into branch ducts. A single key rod provides fast and easy adjustment through the face of a grille or register, and eliminates need for removal. The extractor is sturdily constructed, and fastened in the duct with two screws. Velocity of the air will not alter setting. Write for full information and prices.



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FREE Catalog

listing, describing and pricing 1,000 types and sizes of grilles, registers, etc.

A-J MANUFACTURING Co.

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PACKLESS VIBRATION ABSORBERS

Engineered and constructed for complete and lasting absorption of vibration and noise.

Manufactured of Seamless Flexible Bronze Hose — Tin Bronze Wire Braid Covering — Sizes 3/16 thru 6".

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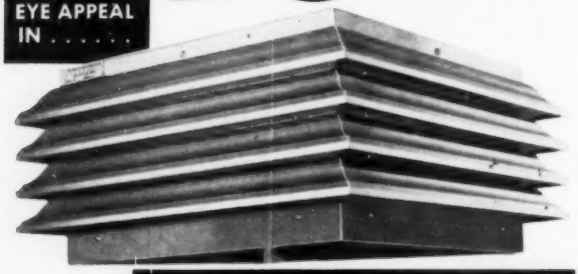
ALL FUNCTIONAL FEATURES PLUS EYE APPEAL IN . . . . . .

Low Silhouette



WAUSAU AIR MOVER

- MODERN DESIGN — Aluminum Extrusions designed to permit low outlet velocities . . . housing completely weatherproof.
- NO UNSIGHTLY CURB MOUNTINGS — Point of Discharge used in design makes unsightly curb mountings unnecessary.
- MORE RIGID WHEEL SUSPENSION — Unique bearing arrangement places fan wheel center of gravity between the bearings provided, more rigid wheel suspension system . . . bearing well also adds rigidity.
- NO INLET OBSTRUCTIONS — Air stream is free of all braces, cross members and other obstructions which produce turbulence and noise.
- EASY ACCESS FOR SERVICING AND LUBRICATING — Bearings are accessible for easy lubricating. Bearings designed for belt drive application; totally enclosed designed for long life . . . motor (ball bearing motor and explosion proof also available).

Write for new catalog, complete details and specifications.

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NEW BOOKS & REPORTS...

An Introduction to Thermonuclear Research, by Albert Simon. 176 pp. Pergamon Press, 122 E. 55th St., New York 22. $5.50

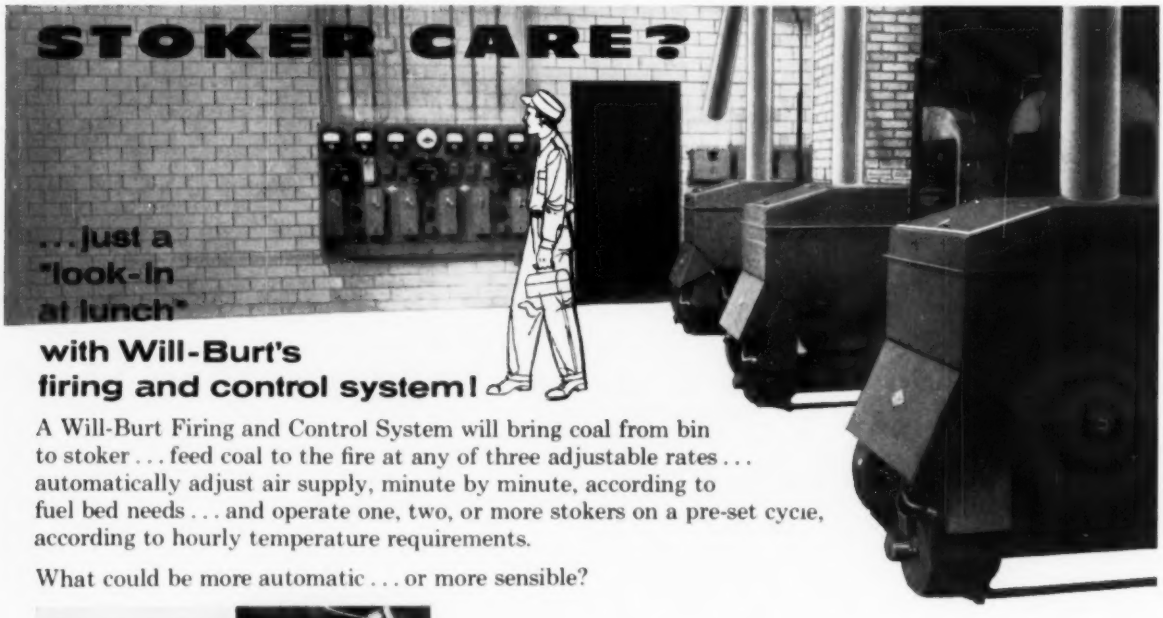
Sanitary Protection of Atmospheric Air: Purification of Industrial Discharge Gases From Suspended Substances, by V. N. Uzhov, translation from Russian by Dr. B. S. Levine. Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. $3.00

Compilation of ASTM Standards Relating to Coated and Uncoated Iron and Steel Sheet and Strip. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $3.00

Industrial Thermal Insulation, by A. C. Wilson. 312 pp. McGraw-Hill Book Co., Inc., 327 W. 41st St., New York 36. $9.00

Fire Prevention and Fire Protection. Bureau of Yards and Docks, U. S. Navy. 190 pp. Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. $3.00

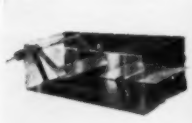
STOKER CARE?



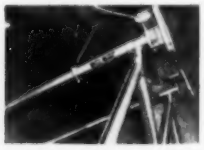
...just a "look-in at lunch" with Will-Burt's firing and control system!

A Will-Burt Firing and Control System will bring coal from bin to stoker . . . feed coal to the fire at any of three adjustable rates . . . automatically adjust air supply, minute by minute, according to fuel bed needs . . . and operate one, two, or more stokers on a pre-set cycle, according to hourly temperature requirements.

What could be more automatic . . . or more sensible?



W-B Automatic self-adjusting Air Control . . . part of every W-B Stoker.



W-B Coal Conveyor . . . power-reversing to clear obstructions . . . operates at any angle.

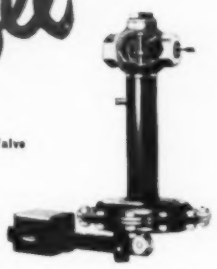
WILL-BURT STOKER

Take our word for it, it's economical. Write direct — or ask your Will-Burt Stoker Specialist for bulletins and help on selection and installation.

WILL-BURT STOKERS • Orrville, Ohio

If you need to reduce
fluid pressure safely, economically...
call for a valve from

Klipfel

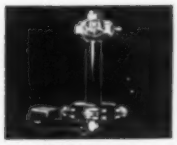


No. 310 Reducing Valve

Klipfel makes Reducing Valves for every purpose—60 different types of them, in fact. They operate on air, gas, steam, water or other liquid, with initial pressures up to 300 psi and reduced pressures as low as vacuum. You can choose from five different inner valves, three different actuating means and four loading means.

Also available from Klipfel are Float Valves, Relief Valves and Temperature Regulator Valves—and special valves made of corrosion-resistant materials. For information on any valve, call your supply house or write for Catalog 54.

Call your supply house, or write for Catalog 54.

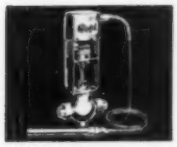


No. 410 Reducing Valve

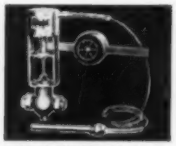
No. 300 Reducing Valve

AIR MAIL

Most items shipped within 24 hours after order is received

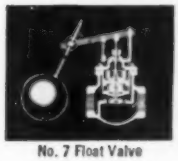


No. K-449 Temperature Regulator Valve



No. K-348 Temperature Regulator Valve

No. 135 Relief Valve



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HAMILTON • OHIO **Klipfel** VALVES, INC.

Automatic Temperature-and-Pressure-Regulating Valves Since 1902

Float Valves • Temperature Regulators • Back Pressure Valves • Reducing Valves

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TRADEMARK

Quickest and Surest Way to Seal Ducts and Insulation

Use a handy roll of Arno Ductape. It sticks instantly and permanently to any surface. For irregular or difficult-to-reach joints tear the tape off in strips for easy application. Where extra safety against fire hazard is needed use Arno F-R (Flame-Resistant) Ductape.

Arno Ductape comes in 60-yard rolls 1, 1½ and 2 inches wide (or wider if needed). Colors are black, tan, olive drab and aluminum gray. It's specially made for duct sealing and other heavy duty jobs.

If you haven't yet tried Arno Ductape ask your jobber or write for a sample roll. You'll like it and the time it saves.

Arno® ADHESIVE TAPES, INC.

Warehouses at New York, Detroit, Atlanta, Minneapolis, Ft. Worth and Los Angeles. Sales offices in other principal cities.

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Please send me a free 15-ft. sample. ☐ Flame-resistant, ☐ Non flame-resistant. I am a ☐ Jobber, ☐ Contractor.

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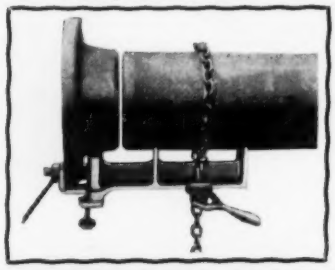
. . . enough JEWEL clamps cut erection costs

PIPE WELDING CLAMPS

Jewel Pipe Clamps are lightweight — rigidly constructed — resist strain, heat and abuse.



FOR WELDING
PIPE • FLANGES • ELBOWS • ANGLES
—also PIPE MARKERS

Jewel Clamps align pipe perfectly, and hold it there until it is welded. Two sizes, ½" to 8"; 8" to 16". Write for details.

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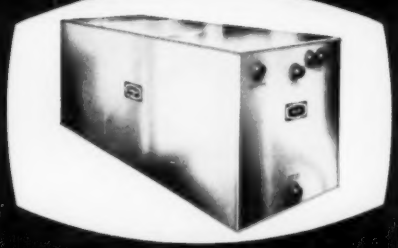
NEW BOOKS & REPORTS

Continued

Compilation of ASTM Standards for Coal and Coke. 136 pp. American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $3.00

Test Methods for Pressure Sensitive Tape Products. Pressure Sensitive Tape Council, 1201 Waukegan Rd., Glenview, Ill. $1.00

1959-60 *Catalog of Technical Data Books published by Lefax Publishers.* Lefax Publishers, 9th & Sansom, Philadelphia 7, Pa. ⫩



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LATENT HEAT STORAGE FOR AIR CONDITIONING

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• THEATRES • OFFICES
• CAFETERIAS • LODGE HALLS

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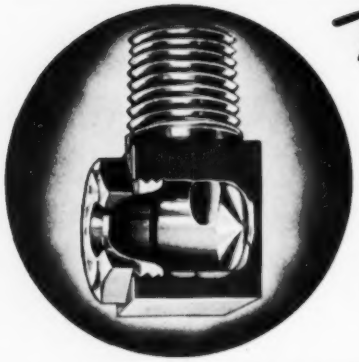
Dole Refrigerating Products Limited, Oakville, Ontario, Canada

DOLE



Monarch

NOZZLES for AIR WASHERS

These are "non-clogging" nozzles with a single large tangential lead hole to the swirl chamber that will never clog from any impurities small enough to pass through the orifice. Swirl chamber is conical on both ends and pivots liquid like a top to produce an exceptionally fine, evenly distributed, balanced spray of about 80° included angle. Wider spray angles up to 130° can be furnished to order.
Standard material Brass. Also available in Stainless Steel and Monel. Pipe sizes from ⅛" to 1". ¼" size is 1-5/16" long and made from ⅝" square stock.

Write for Catalog I

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Canadian Agents: (Except B. C.)
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the right combination for smooth, uniform 90° bends on copper tubing...

HEIN-WERNER PORTABLE TAL BENDER
Set No. 3-CT is complete!

Cut installation time in half by bending copper tubing up to 3" with TAL BENDER Set Number 3-CT — it's complete; Set includes basic 3" TAL BENDER; six 1" to 3" (nom.) bending shoes, bars and clamps designed specifically for hard and soft copper tubing K & L; necessary connecting parts and special bending frame all in sturdy wooden chest. High speed TAL BENDER MP-27 Motor Pump may be used for faster bending. Write for detailed Catalog No. 35, or see your plumbing and heating wholesaler for full information.

Hein-Werner CORPORATION
WAUKESHA, WISCONSIN

Loosens Rust and Corrosion

Quickly frees 'frozen' parts!

LIQUID WRENCH

The Super-penetrating Rust Solvent

powerful blend of fast-acting solvents that literally "melts the rust away"

Works FAST!

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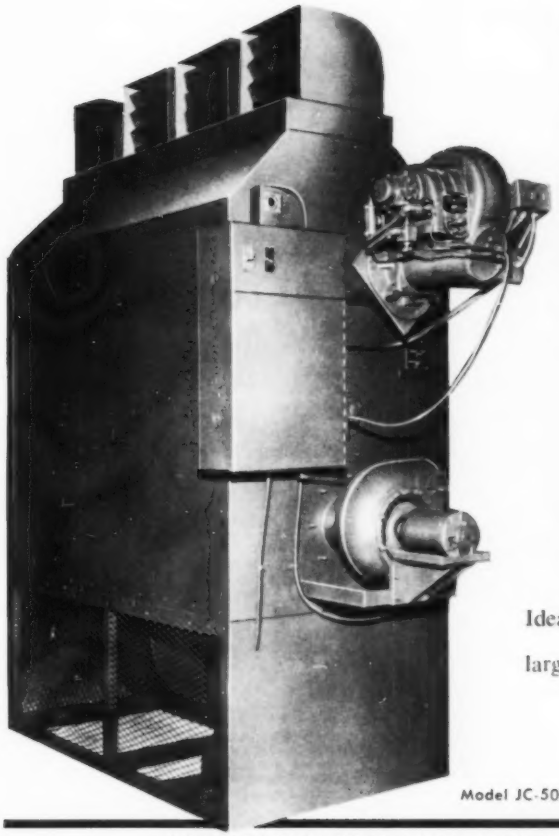

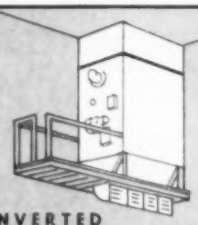

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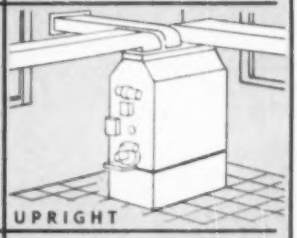

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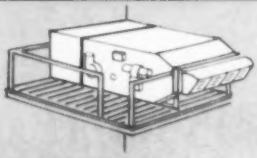

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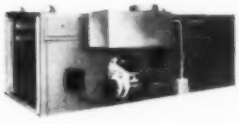

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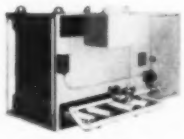

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Everything you need in Dial Thermometers for Piping *and* Duct work!

A new and complete line of instruments: Dial thermometer of Marsh precision and accuracy designed down to the last detail for piping and duct work . . . for use on heating and cooling equipment, air ducts, vessels and kilns, ovens and similar applications.

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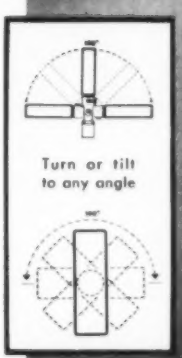

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0° to 160°F
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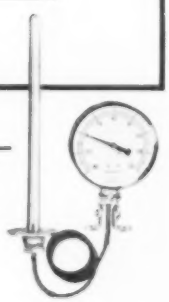

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Statement of Ownership and Management of
HEATING, PIPING & AIR CONDITIONING
for October 1, 1959

The following is a statement of ownership, management, etc., as required by the act of Congress of August 24, 1912, as amended by the acts of March 3, 1933 and July 2, 1946 (Title 39, United States Code, Section 233) of Heating, Piping & Air Conditioning, published monthly at Chicago, Ill., for October 1, 1959:

1. The names and addresses of the publisher, editorial director, editor, and president are:

Publisher, Chas. E. Price, Glencoe, Illinois.
Editorial Director, C. M. Burnam, Jr., Chicago, Illinois.
Editor, Robert W. Roose, LaGrange, Illinois.
President, Chas. E. Price, Glencoe, Illinois.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member must be given.)

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3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

Chas. E. Price, President

Sworn to and subscribed before me this 2nd day of September, 1959.

Lydia Thomas,
(SEAL) [My commission expires November 22, 1959]

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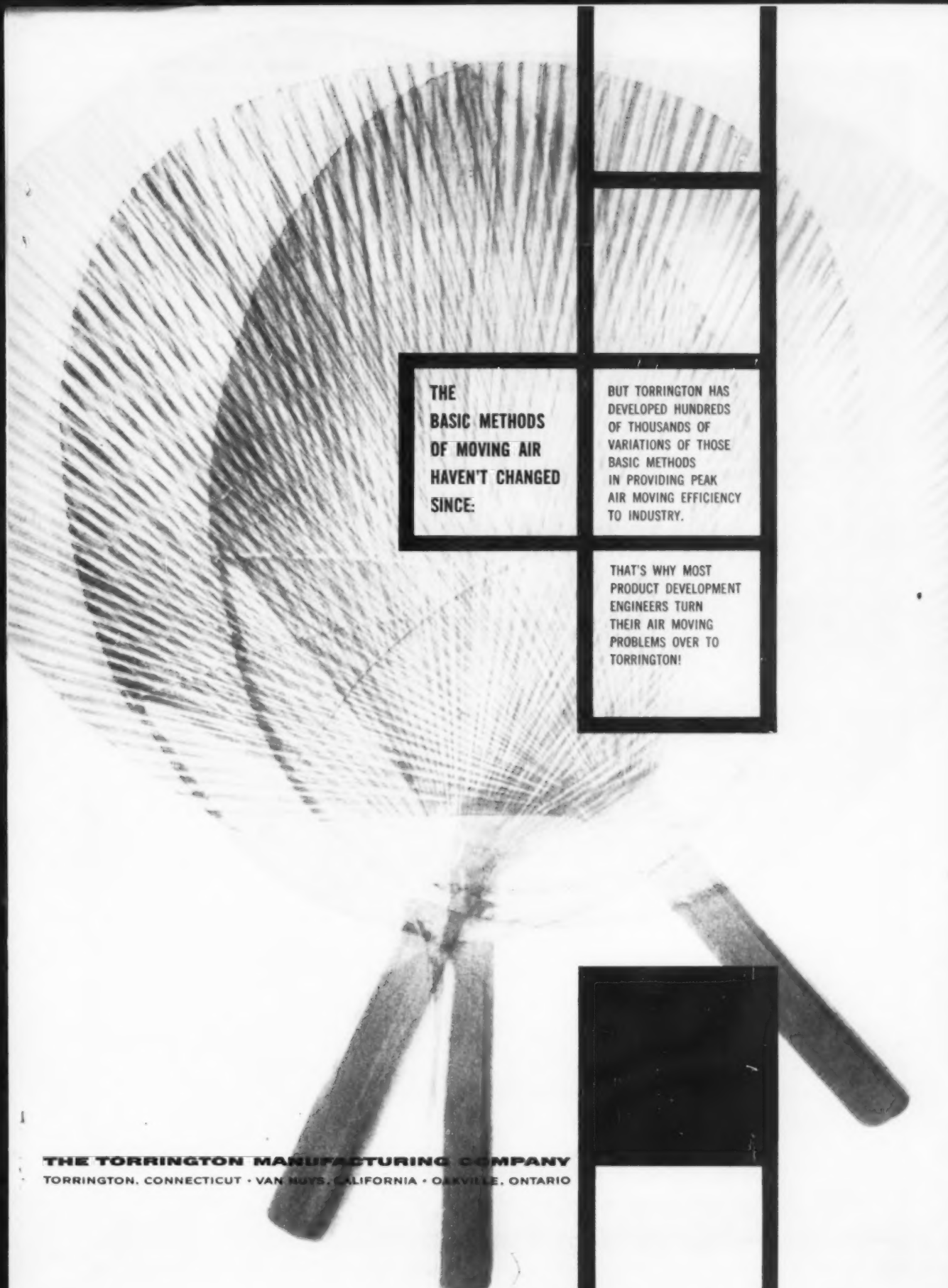
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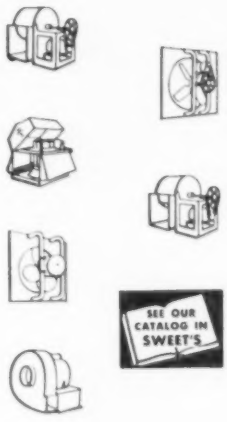

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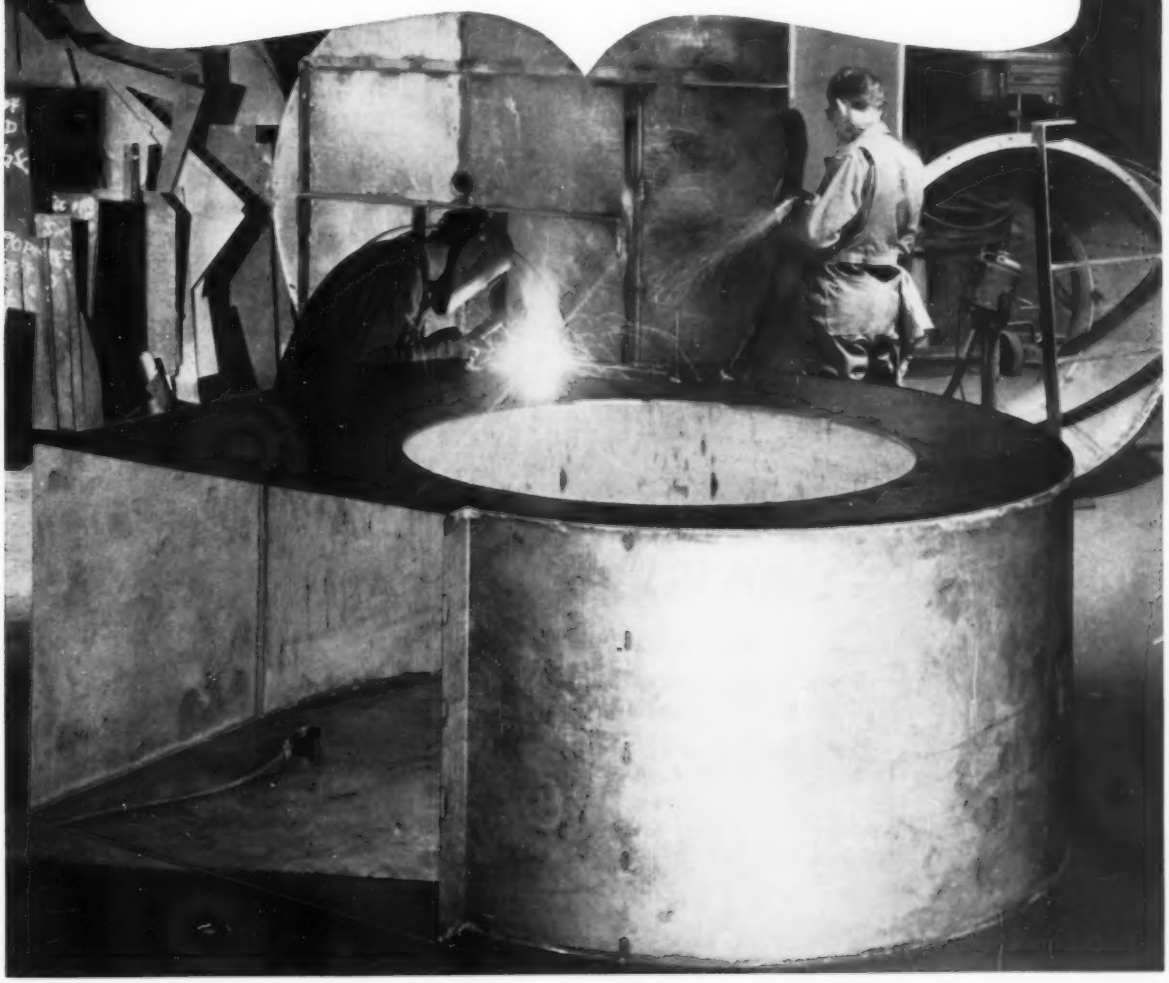

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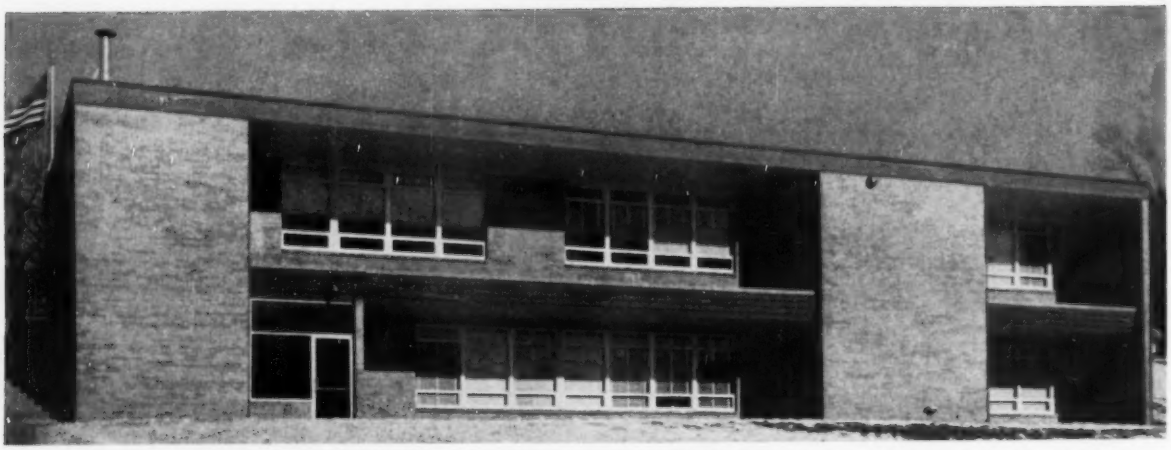

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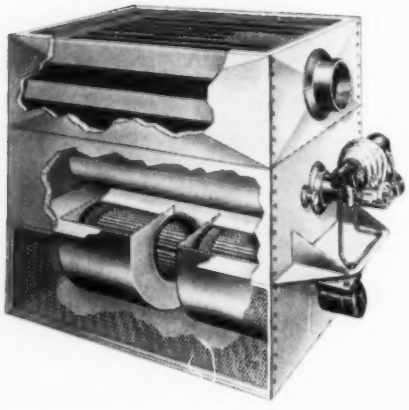

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